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Our Earth and Sky

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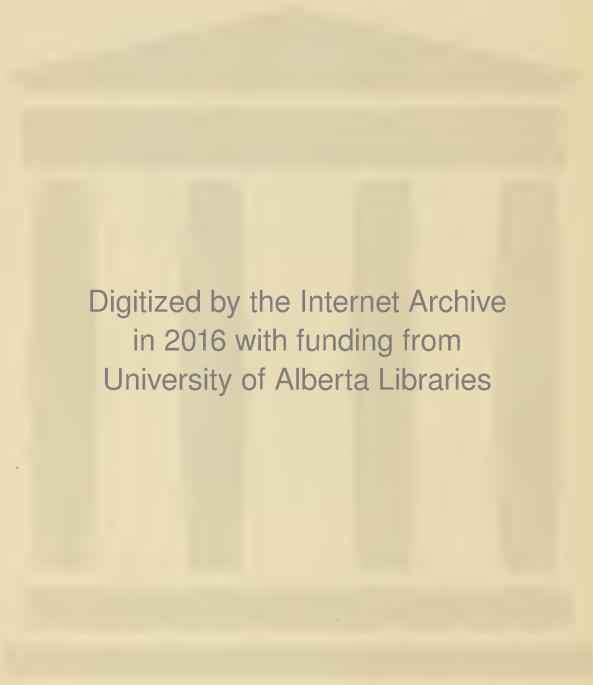


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NEW · PATHWAYS · IN · SCIENCE

Our Earth and Sky

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New Pathways in Science

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We Want to Know
CRAIG • BURKE • BABCOCK

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We Find Out
CRAIG • BURKE

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Changes All Around Us
CRAIG • BALDWIN

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Our Earth and Sky
CRAIG • BALDWIN

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The Earth and Life Upon It
CRAIG • HURLEY

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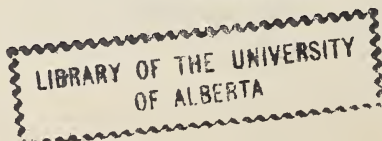
From Sun to Earth
CRAIG • CONDRIY • HILL

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The Earth Then and Now
CRAIG • JOHNSON • LEWIS

The Athenæum Press

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Our Earth and Sky

HAVE you ever wondered about the sky? Should you like to sail around among the stars? When you came back to the earth you could tell strange things about your travels.

People have always wondered about the things they could see in the sky. They have asked many questions.

What are the bright things that shine in the sky?

What are they made of?

What makes them shine?

Are they really little or are they big and far away?

Through all the years, people have asked these and other questions about the sky. They could not go up to the moon and stars. Even now they cannot fly so high. How could they find out the things they wanted to know?

At first they made up stories about the sky. People in different parts of the world made different stories. By and by they began to believe their stories. Many people thought they were true.

Later, people learned better ways to find answers to their questions about the sky. That was when science began.

People have wondered also about the world they live in. They looked at the earth and wondered how it came to be here.

Where did the rocks come from?

How were the mountains and oceans made?

Where did the air come from?

How did plants and animals begin to grow?

People tried to think how the earth was made. Again they made up stories. Perhaps you have read some of the stories the Indians made about the beginning of the earth.

Later, scientists tried to find answers to these questions about the earth. It was very hard to find out about some things. While scientists do not know for sure how the earth was made, they have found out many things which seem to be true.

Sometimes scientists find that their answers are wrong. Sometimes they find out new things which change what they thought was true.

This book will tell you some of the things which scientists believe about the sky. It tells some of the things they believe are true about the earth and the living things on it.

I

The Story of the Sky

ABOUT THE SUN

WHAT ARE THE STARS?

WHAT IS THE MOON LIKE?

THE EARTH WE LIVE ON



How far away is the sun?

How large is the sun?

What is the sun made of?

What are the stars?

What is the moon like?

Children ask these questions from the time that they ask about anything. Grown-ups asked these questions for thousands of years before they found answers which were very nearly true.

Every day scientists are learning more wonderful things in answer to these questions. Many of these things are found in "The Story of the Sky."

THE COLORED PICTURE IS FROM A PAINTING BY CHARLES BITTINGER.

About the Sun

HOW FAR AWAY IS THE SUN?

The earth is ninety-three millions of miles away from the sun. Miles, miles, miles, miles, miles, and miles are between the earth and the sun. Can you think how far such a great number of miles must be?

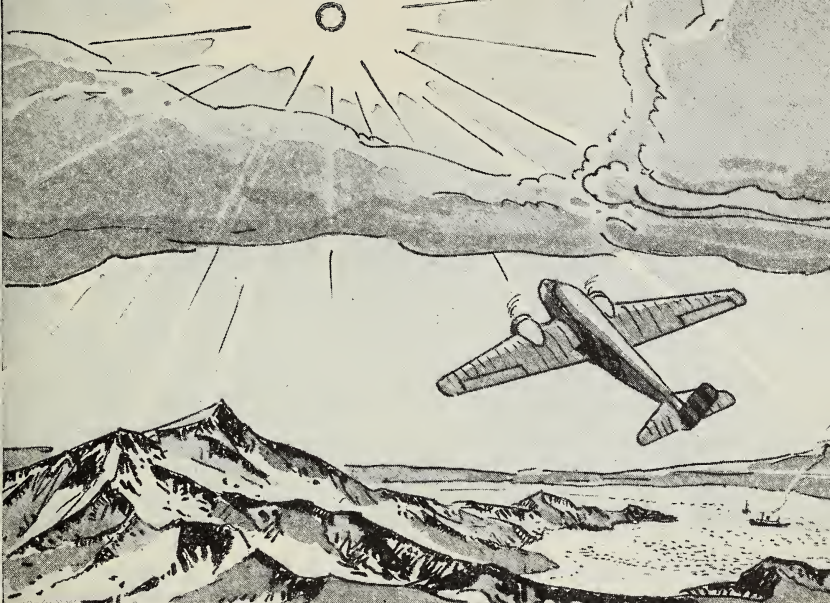
Is it farther than from your house to the north pole? Is it farther than from your house across the ocean? Is it farther than a trip around the earth?

We can answer all these questions at once. The sun is many times farther away from us than all of these journeys put together.

What is the farthest place of which you have ever heard? Is it Africa? Is it Little America at the south pole? Do you know how many miles away these places are? Probably they are many thousands of miles away from where you live. But they are really very close when we think of the miles and miles between the earth and the sun.

What is the longest journey you have ever taken? What is the longest journey any of your friends have taken? The sun is very, very much farther away than the longest journey that anyone has ever taken.

Do you know anyone who has taken a trip around the world? That is a long, long journey. It takes



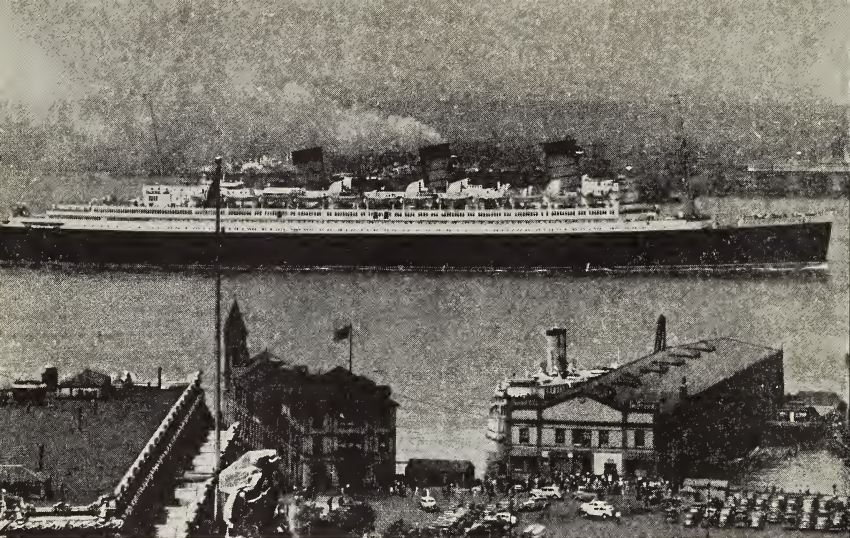
Suppose we could fly to the sun on this airplane.

Do you know how long it would take us to reach the sun?

several months to travel around the world by boat and train. But it would take nearly four thousand trips around the world to go as far as from the earth to the sun. Do you think anyone could live long enough to travel so far?

Think of flying to the sun. Tell all the reasons you can why people could not really fly to the sun.

Perhaps each boy and girl said, "You can't fly to the sun because it is too far away." That is one very good reason.



Gendreau

This is one of the largest and fastest boats in the world.

Read about a make-believe trip to the sun on this boat

Suppose that a make-believe aviator should take a trip to the sun in a make-believe airplane. And suppose he should travel as fast as most aviators travel on long journeys.

He could make no stops for rest or for gas and oil. There would be no place for him to stop. Yet racing along as fast as he could go, it would take him eighty years to fly to the sun.

Do you know anyone who is eighty years old? How does he look? How does he walk? Our make-believe aviator would be older than that by the time he reached the sun. What a long, long ride!

Suppose, instead, that train tracks could be laid on the sunshine. It would take our fastest trains nearly two hundred years to reach the sun. Your grandmother's grandmother was not born two hundred years ago.

On page 10 is a picture of one of our fastest ocean boats. If this boat could travel to the sun, it would take it more than three hundred and fifty years to reach the end of its journey.

Three hundred and fifty years ago all this land belonged to the Indians. Forests covered the land. There were no cities. There were no trains. There were no farms with great barns, cows, and horses.

Suppose that someone could have started to go to the sun on this boat when white people first came to live here. After traveling for all those years he would still have many miles to go.

What a long, long journey! Did you think that the sun was so far away from the earth?

THINGS TO THINK ABOUT

1. Alice Smith went to visit her grandmother, who lives ninety-three miles from Alice's home. Alice was on the train nearly two hours. Suppose she could take a million trips to her grandmother's home. Then she would have traveled as far as from the earth to the sun. It is a long, long way to the sun.

2. Marie Bracco has just come to our school from Italy. She traveled nearly four thousand miles to get to this country. It took her more than a week to get here. But just think of this: The sunshine which comes into your window has traveled more than twenty thousand times as far as Marie traveled. Yet it took less than ten minutes to get here!

3. Last summer the Nelson family took a long trip in their car. They traveled away across the country and back. They traveled from the Atlantic Ocean to the Pacific Ocean. Jane and George told the children at school that they had traveled over seven thousand miles. Some of the time Mr. Nelson drove very fast. They traveled all summer in their car.

Make believe that they said when they reached home, "Let us take a longer trip next summer. Let us take a trip to the sun."

Then suppose that they could drive away toward the sun. Suppose they should travel toward the sun as fast as the fastest cars can travel. Mr. Nelson might say, "This will be a long trip. We must travel night and day."

Do you know how long it would take them to reach the sun? If they should travel for two hundred years in their fast car, they would be somewhere near the sun.

Two hundred years is a long time. The world will be greatly changed in two hundred years. Do you know of anything that happened two hundred years ago? George Washington was a young boy two hundred years ago. There were no trains or busses then. There were no stoves. There were no machines such as we have today to work for people.

Just think of the miles and miles to be traveled in two hundred years. What a long trip to the sun!

4. One day Jane said, "If we could travel as fast as we can think, perhaps we could reach the sun."

The children in Miss Smith's room liked to talk about this plan. "We can think very fast," they said.

George said, "Of course this could not happen. But let's suppose that we could travel a mile every time the clock ticks. Let's suppose we could travel a mile in every second. How long would it take us to reach the sun?"

It would take more than three years to reach the sun, if we could travel a mile in one second. The sun is far away indeed.

HOW LARGE IS THE SUN?

How large do you think the sun is? Is it as small as it looks? Is it bigger than a house?

Look at the sun through a piece of blackened glass. You will see that it looks like a round bright light. Some people say that it looks as large as a man's head. Other people say that it looks about as large as a pumpkin.

We all know that the sun looks so small because it is millions and millions of miles away. How large do you suppose the sun really is?

Of course we know that the sun must be very large to send its great light so far. The sunlight is very, very bright. Sometimes it is so bright that it



Whenever you look straight at the sun, you must use a blackened glass.
The sun is so bright that we cannot look at it in any other way.

hurts our eyes. You often have seen men and women, and even children, wearing dark glasses. They wear them to keep the bright sunlight away from their eyes. The sun must be very large to throw its bright light so many millions of miles.

You know that the sunlight is often very hot. The sun often burns people's skin. Did you ever have a bad sunburn? Sometimes the sun makes the ground very hot. It is so hot that it burns people's feet or hands when they touch it.

The sun must be very large to send its great heat so many millions of miles. Let us find out how big it really is. Is it larger than your town? Do you think it is larger than our whole country?

Our country is a very big place. Suppose you should travel about the country all summer. There would be many, many places which you could not see. It would take many summers to see all the places in our country. Yet the sun is much, much larger than our great country.

This big bright light which we call the sun is much larger than the whole earth. It is many, many times larger than the earth.

The big earth is a tiny ball beside the great sun. Suppose some strong giant could roll together into a great pile thousands and thousands of earths as big as ours. He would have a pile about as large as the sun.

Here is another way to show how large the sun is. Let us suppose that a family of people would be able to reach the sun in an airplane. They want to see all of the outside of the sun.

There is a baby in this make-believe family. They travel on and on over the sun for days and years. The tiny baby grows up to be a man. The people have seen only a small part of the sun.

They travel on and on trying to see all parts of



Chicago Aerial Survey Company

This great city covers many miles. But it is only a tiny part

the sun. The man who was a baby when the family started is now an old man with white hair.

For years and years and years these people have been riding around over the sun. Yet they have seen less than one half of the outside of the sun.



of our earth. The sun is larger than thousands of earths

How very, very big the sun is! No wonder the summer sun is so hot! No wonder the sun is so bright that we can look at it only through a piece of blackened glass. No wonder the sunlight sometimes gives us a sunburn.



How does the earth look as you see it through your window? Suppose you could be as close to the sun as you are to the earth. How do you think the sun would look to you then?

WHAT IS THE SUN MADE OF?

The sun is quite different from the earth. As you look out of your window, the place where you live looks about the same each day. You see the same trees and fields or the same city streets.

Sometimes the wind blows things about. But most of the things that are a part of the earth stay very still. The hills, rocks, mountains, and trees,

the lakes and rivers, all stay in the same place year after year.

If you could be a make-believe boy or girl on the sun, things would look quite different. Nothing stays still on the sun. There are no mountains or hills, no rocks or lakes or rivers. The sun is made up of hot gases.

Do you know what gases are? The air is the gas that most of us know best. The air is made up of a number of gases. Sometimes the air becomes very hot. In some hot places on the earth the thermometer climbs away up to more than 100° . The hot wind seems to burn as it blows against people.

But the air in these places never becomes so hot as the gases of the sun. The gases of the sun are so hot that they shine and give off light.

The earth and the sun are very different. The earth is made up of air, land, and water. There is no land on the sun. There is no water on the sun. The sun is just hot gases.

These hot gases are always moving. They go whirling about year after year. They have been pushing and turning and giving off light for years without number.

Suppose a make-believe aviator could fly as far as the sun. He could never know what it is like to

be really close to the sun. He would have to keep hundreds of thousands of miles away from it.

Great streams of hot gases are always shooting out from the sun. These streams of hot gases are hundreds of thousands of miles long. They are the hot gases of which the sun is made.

An airplane could not land on the sun, because there would be no ground on which to land. It would fall right through these gases when it tried to land. If the airplane were anywhere near the sun, its metal body would boil as water boils on a hot stove.

Sometimes scientists take pictures of the sun.

These pictures show great streams of hot gases that look like this



When you try to think what the sun is like, do not think of it as a great open fire. It is not made of thousands of fires as big as the world. The sun is not fire. It does not burn and smoke.

For a fire, we use wood or coal or something else which will burn. These things will burn out after a while. The sun's gases will not do this—not for millions of years at least.

The sun gives off heat and light without being fire. Scientists are not sure what does make these gases so hot. But they believe that the sun will go on shining for millions of years, just as it shines today.

THINGS TO THINK ABOUT

Nothing on the earth is so hot as the sun. If all the hot fires on the earth could be put together, they would not be so hot as the sun.

When you think how hot the sun is, are you surprised

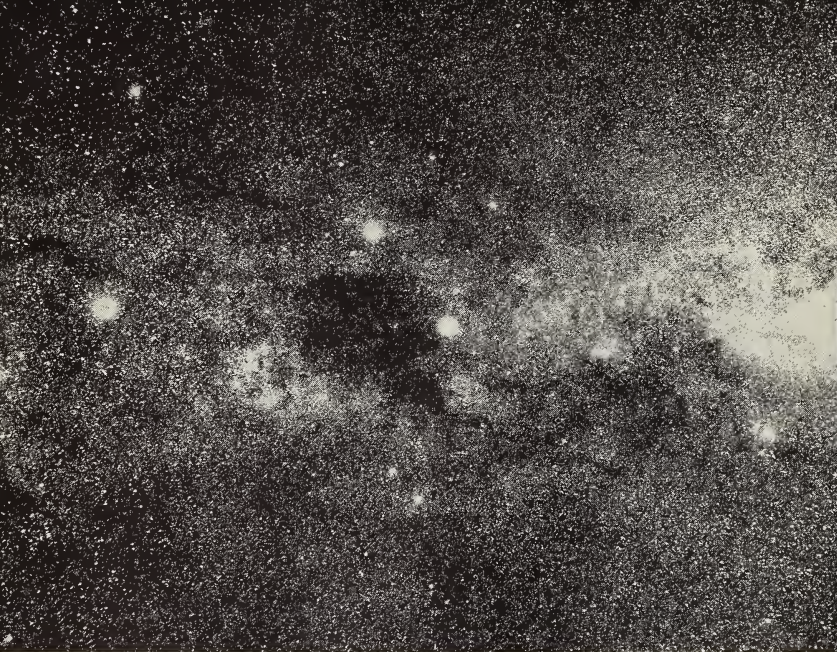
1. That streets dry quickly when the sun shines on them after the rain?

2. That sidewalks sometimes burn our feet in summer?

3. That ice and snow melt away when the warm spring sun shines upon them?

4. That people have been known to cook an egg on the sidewalks on a hot day just for fun?

Try to tell some more of these "Are you surprised" thoughts.



Harvard College Observatory

The sky full of stars is a wonderful sight. Have you ever seen the part of the sky that looks like this? These stars form what is called "The Milky Way"

What Are the Stars?

STARS ARE SUNS

Do you know that our sun is not the only sun there is? There are millions of other suns. Do you know where these suns are?

When you look up into the dark sky full of bright stars, you can see thousands of suns. The stars look like tiny points of light. An old song says a star is

"like a diamond in the sky." But the stars are larger and more wonderful than a whole house full of diamonds.

The stars are great suns. Many of them are larger and hotter than our sun is. They are made up of hot gases, as our sun is. The gases of the stars are so hot that they shine and give off great heat and light. The heat does not reach the earth. But the light travels hundreds of thousands of millions of miles and is seen by us at night. These stars must be very hot and very bright to send their light so far.


Stars are suns, and suns are stars.

Our sun is a star, too. It gives us much more light than the other stars do. But it is not larger than most of the other stars. It seems bigger and brighter than the other stars because it is very much closer to us than they are.

When you are in your house at night, your own lamps seem bigger and brighter than those in

Have you ever seen these stars in the sky? They are called "The Big Dipper"

Verkes Observatory



Jimmy's house across the way. They seem brighter and bigger, of course, because they are closer to you.

HOW LARGE ARE THE STARS?

Some of the stars are larger than others. Some are quite small. Some are not much larger than our earth. Many stars are about as large as our sun. Other stars are much, much larger than our sun.

Suppose one of these larger stars could change places with our sun. Our earth would be so hot and so bright that people would not be able to live here at all.

If a make-believe aviator could fly through one of these largest stars, he would need to travel for hundreds of years. He would travel millions and millions of miles to go from one side of the star to the other. Some stars are as far across as the miles between the earth and the sun.

These stories about the stars seem very strange. It seems as if they were made up and were not true stories. But scientists tell us that they are true. They tell us other things about the stars that seem just as strange and are just as true.



It is easy to see that the sun is shining in this picture. The stars are shining, too. They do not light the earth as the sun does, but they are shining just the same

STARS SHINE ALL THE TIME

The stars are in the sky through the day just as they are at night. We do not see them shining in the daytime because the sun, our great star, gives us so much more light than they do. It gives us more light because it is nearer to us.

At night, when our part of the earth is turned away from the sun, the light of the other stars can be seen through the darkness. Then the sun does

not give us greater light. We see the stars shining like thousands of diamonds.

We know that they never stop shining. Their light cannot be turned off as we turn off an electric light. It shines on and on, night and day.

Sometimes people have seen stars in the daytime. They have seen stars through a telescope in the daytime.

Sometimes you can see a very bright star early in the morning when the sun first begins to shine. Watch the sun set late in the day. Look to see the first star in the light-blue sky.



Bob and Sandy can see to run by the moon's bright light.

But the moon's light is not so bright as the sun's light

What Is the Moon Like?

THE MOON'S LIGHT

Were you ever out of doors in the moonlight? Have you ever played "touch last" in the moonlight? Have you ever been taken for a boat ride in the moonlight? Could you see just where you were going and what you were doing?

The moon gives more light to the earth than the stars do. Sometimes we say, "The moonlight is

almost as light as day." Yet the moon is not a sun as the stars are.

The sun and stars make their own light. The moon has no light of its own, any more than the earth has. The moon gets its light from our sun. The light which it gives out is reflected light.

By reflected light we mean something like this : When you look into a mirror, you do not see your real face. The mirror seems to throw your face back to you. What you really see is the reflection of your face.

Sometimes the sunlight which is shining on Mary's house will make rooms in Jimmy's house very bright. Jimmy's house is bright by reflection.

Have you ever caught some of the sun's light in a mirror ? And have you watched the bright light dance around the walls of the room ? This "light bird" is reflected light.

In the same way, the moon reflects the sun's light to the earth and makes it bright at night.

Where can you see other reflections ?

IS THE MOON LIKE THE SUN?

Although the moon and the sun both give light to the earth, they are quite different in most ways.

The sun is a great ball of hot gases. The moon is not made of gases. It is as hard as the earth is.

You know that the stars make their own light. The gases of which they are made are so hot that they shine. The hot gases are so bright that their light goes far, far beyond the earth.

The moon does not make its own light from hot gases as the sun does. The moon's light is reflected light. The moon's light comes from the sun. Because its light does not come from hot gases, the moon is not so hot as the sun is.

The moon is very much smaller than the sun is. The moon is much smaller than the earth is. It would take about fifty moons to make one earth.

Bill, Bob, and Anne are catching the sun's light in mirrors. Look at the light spots on the wall of the house. These spots are reflected light

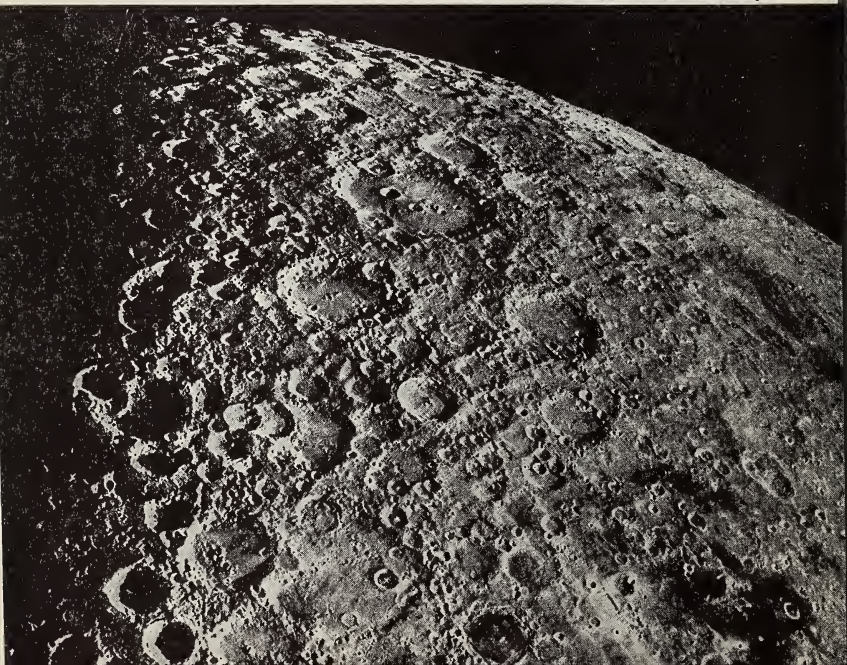


You know that it would take thousands and thousands and thousands of earths to make a body as large as the sun. It is hard to think how many moons it would take to make a body as large as the sun.

Millions of miles lie between the sun and the earth. When we think of this, the moon seems very close to the earth. The moon is closer to the earth than any other body in the sky. It is the earth's nearest neighbor.

Part of the moon looks like this when it is seen through a telescope

Mount Wilson Observatory





Fairchild Aerial Surveys

Part of the earth looks like this as it is seen from an airplane.

How is it different from the picture of the moon?

Mary's great-uncle Bob was an old sailor. He had sailed around the world ten times. His travels had taken him as far as the miles between the earth and the moon.

Think of a make-believe trip to the moon on a fast train. This trip would not be nearly so long as a make-believe trip to the sun. Instead of traveling nearly two hundred years, you could reach the moon in less than one year.

IS THE MOON LIKE THE EARTH?

On some nights the moon looks very close to the earth. It seems as if we could almost touch it if we should climb to the top of some very high place.

Suppose that magic could carry you to the moon. The moon looks very beautiful when it is shining away in the sky at night. But it is not nearly so pleasant a place as the earth is. You would not have a good time at all on your make-believe visit to the moon. Some scientists believe the moon would look like the picture on page 33 if we were close to it.

There is no air on the moon, and there is no water. People who look at the moon through telescopes do not see anything which looks like clouds. You would find no wells, rivers, lakes, or oceans. The moon is as dry as a desert.

Where there is no water, you would not find grass, trees, flowers, or animals. Nothing grows on the moon.

It would not be pleasant to take a walk on the moon. You would have to walk over sharp, uneven rock. You would have to climb over high mountains. The sides of the mountains would be nearly straight up and down. The rocks on the sides would be sharp and pointed.



Scriver Bellon

Many of the mountains on the moon are higher than most of the mountains on the earth. The sides are more nearly straight up and down. The tops are more pointed. The rocks on the sides are more sharp and pointed than most of the rocks on the earth.

It would not be safe to stand quietly and watch the sky at night during this visit. The weather on the moon would be most unpleasant. The night side of the moon is very, very cold. You would freeze, no matter what you might take along to keep you warm.

The day part of the moon is very, very hot. Most of your body would boil away if you were there. Even make-believe people could find no place to stay on the moon.

You see, the moon is both hotter and colder than the earth is. Do you wonder why?

A day on the moon is as long as fourteen days on the earth. A night on the moon is as long as fourteen nights on the earth. The moon becomes very, very hot during this long day. It becomes very, very cold during the long, long night,

Fourteen earth days of sunlight make part of the moon very, very hot. It is much hotter than a day ever is on the earth. Fourteen nights of darkness make part of the moon very, very cold. It is much colder than a night ever is on the earth.

THINGS TO THINK ABOUT

1. Sometimes it is fun to make believe. Try to make believe that you could live comfortably on the moon. During one of your moon days your friends at home would be having fourteen earth days.

They would go to school ten days. They would have two Saturdays for play. They would go to Sunday School two times.

At the end of seven earth days, you would be having noon on the moon. Could you wait so long as that for your lunch?

At the end of the next seven earth days, night would come to the moon. You would not make a fuss about going to bed at the end of a moon day, would you? You would get a long, long rest though, for the night would be just as long as the day.

2. The moon makes the earth much brighter than the light of all the stars put together. Yet the moon seems no bigger than a dot when we think of the stars.

Can you believe that? Let us think it out. Are the stars suns? Are many of them much larger than our sun?

Write the following sentences on a piece of paper and see if you can finish each of them. Then you can see why moonlight is so much brighter than starlight.

a. The stars look small because they are ___?___.

b. The stars give us little light because they are ___?___.

c. The moon gives more light because it is so ___?___.

THINGS TO DO

1. Tell which boy was right.

Bob said to Bill, "Moonlight is sunlight."

"How could it be?" said Bill. "Moonlight comes from the moon and sunlight comes from the sun. Moonlight cannot be sunlight."

Which boy was right? If you cannot tell, read pages 28 and 29 again.

2. Make fifty-one balls of snow or clay. Save one for a moon ball. Put all the rest of the balls together for an earth ball.

Your moon ball looks very small beside your earth ball, doesn't it?

3. Here is something to do if you have a pair of field glasses.

Some night when the moon is full and round, look at it through your field glasses. You will be surprised to find how plainly you can see the mountains on the moon.

The Earth We Live On

OUR EARTH, TOO, MOVES ABOUT IN THE SKY

Has "The Story of the Sky" helped you to learn new things about what the sky is like? When you were small, what did you think the sky was like? Did you think it was like a high roof over all the earth?

Of course you know now that this is not true. The sky goes on and on and on. The sky reaches as far away as any of the stars are.

You have read about many things that are in the sky. Millions of stars send out their light day and night, year after year. Our own sun shines out through the sky. The moon, the earth's nearest sky neighbor, is always moving about and reflecting light.

Our earth, too, moves about in the sky. It moves about with the other great bodies in the sky.

Take another make-believe visit to the moon. Look up into the sky at night during this make-believe visit. You probably would see a very bright light which looks like another moon. It would look like a very large moon. Instead of another moon, however, you would know that this bright light is our earth. It is giving reflected light to the real moon.

You would be able to see then that our earth is a part of the sky. It is a part of the sky just as surely as the sun or the moon or the stars.

HOW VERY BIG OUR EARTH IS

In the daytime, when you play out of doors, the earth seems very large. It seems to have no end.

In cities the parks, the streets, and the buildings seem to be all there is to the world. In the country the hills, the woods, the fields, and the farms seem to reach everywhere. The land seems to have no end. But great places like these are as tiny dots when you think of the rest of the earth.

Children measuring journey strip on globe

Lang



Did you ever try to find your town on a globe or on a map of the world? Perhaps your town is too small to have its name on a world map. Then find a large city which is somewhere near your home. Just a dot is used to show this big place!

On the globe find the longest journey you have ever taken. Cut a piece



of paper as long as your journey measures on the globe. Now cut a piece long enough to reach all the way around the globe. Place your "journey" piece of paper beside the "round the globe" piece of paper. How do they look together?

Cut a piece of paper as large as the United States is on the world map. The United States is a very large country. Fast trains take four days and four nights to cross it. Lay your United States piece of paper over other places on the world map. How many, many pieces of paper like this it would take to cover the whole world map!

A fast boat takes about five days and five nights to cross the Atlantic Ocean. This is not the largest ocean.

Our earth is a very, very large place. Don't you think so?

HOW VERY SMALL OUR EARTH IS

The earth seems like a very large place indeed when people are traveling around it.

But suppose that you could find a great giant who could travel around through the sky. Suppose that he could ride from one sun to another as easily as we can ride from city to city.

Suppose that this giant should say to himself, "I should like to find that wonderful place called the earth. So far as I know, it is the only place where people live."

Then he would ride around for millions of years. He would look in and out among the suns, around and about the suns, to find this place called earth. If a giant could travel about in this way, he might pass the earth a dozen times without seeing it at all.

Our earth would be very hard to find among the stars. It would be as hard for such a giant to find it as it would be for you to find a needle in a pile of hay.

THINGS TO THINK ABOUT

Which of these thoughts do you think is more nearly true?

Our earth is very small

or

Stars are so large and so far apart that our earth
seems very small beside them

II

What the Sun Gives Us

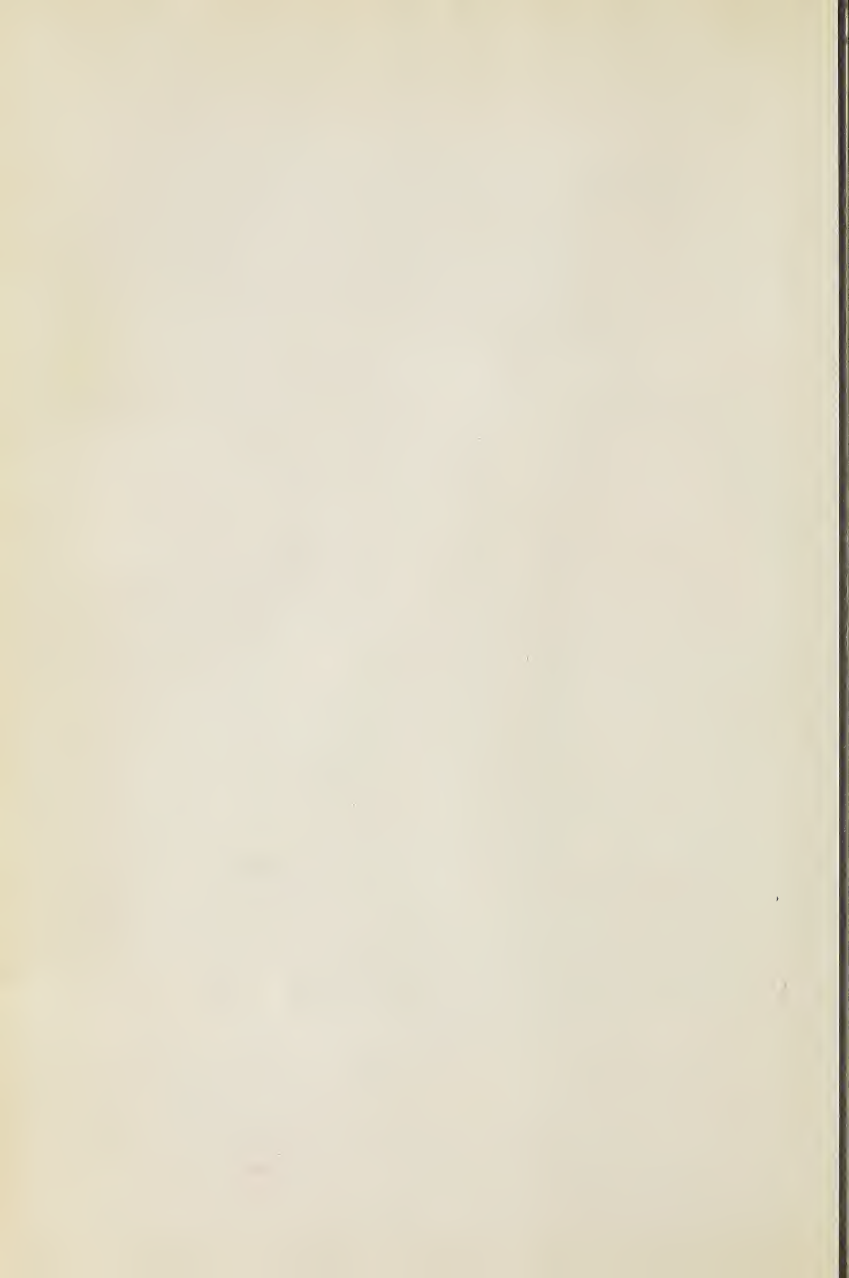
LIGHT AND HEAT COME FROM THE SUN

THE SUN GIVES US COLOR

THE SUN GIVES US FOOD







Can you answer these questions ?

1. Which do we need most in the cold winter-time, our stoves and furnaces *or* the sun ?

Why ?

2. Where do plants get their food to make them grow ?

Why are healthy people able to work hard and play hard ?

3. Why do we not see

trees with black leaves ?

black grass ?

gray flowers ?

gray people ?

THE COLORED PICTURES ARE FROM PAINTINGS BY COURTNEY ALLEN.

Light and Heat Come from the Sun

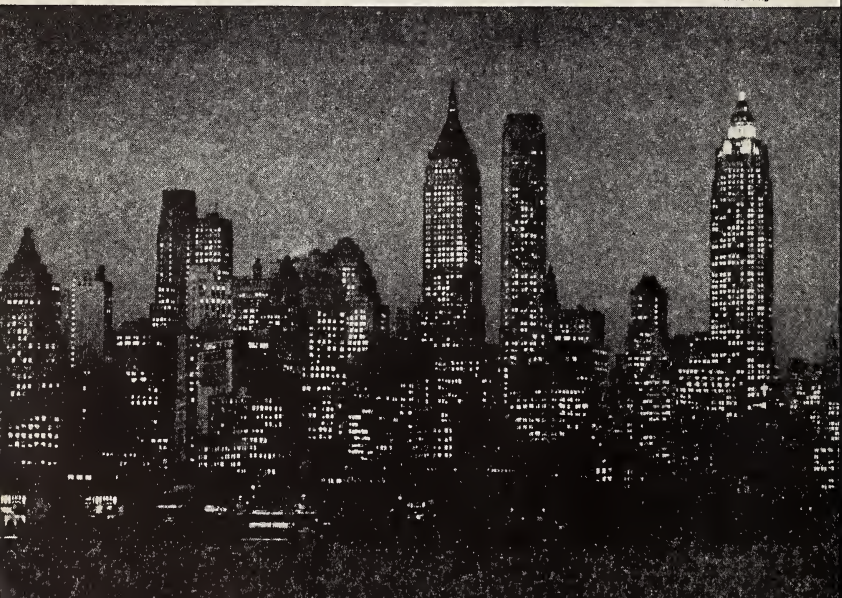
How many ways of heating and lighting can you name? Are these ways just as good as the sun's lighting and heating?

Of course we have very strong electric lights to see by at night. Some streets in our cities are almost as light at night as they are in the daytime. But only a few streets of a city are nearly as light as day. Cities have not enough money to keep all their streets so light as that.

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Thousands and thousands of electric lights make the city very bright at night

Galloway



Electric lamps give our homes enough light at night for us to work or play as much as we wish. But the lamps in your home keep only your house light. They do not make enough light for people in Jimmy's house across the way to see to read or to play.

Some of the strongest lights in the world are the great lights which show aviators where the landing fields are. At night these lights shine for miles into the darkness. But suppose someone should turn on these great lights on a sunshiny day. They would not seem bright at all. If we were not standing

All the lights of the city put together are not so bright as the sun's light

Galloway



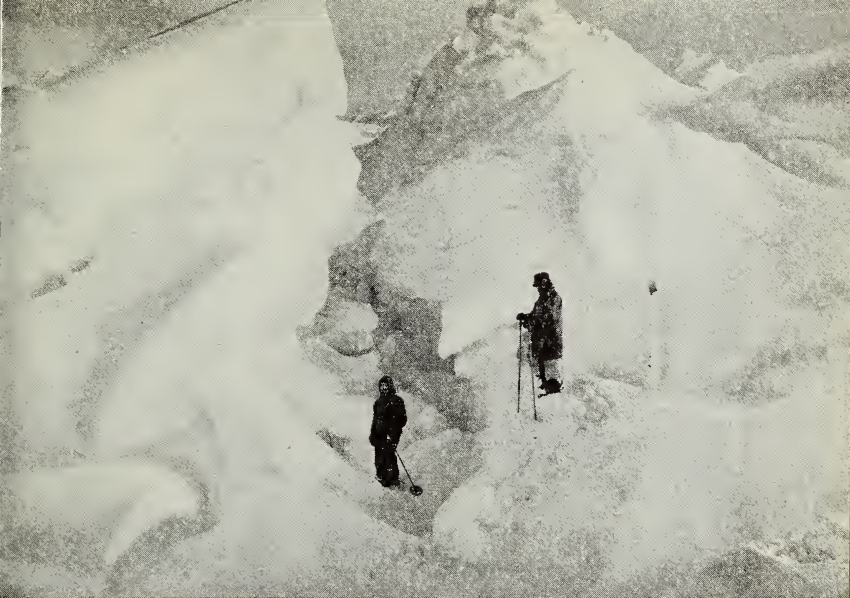
close to them we should not know they had been lighted. The sun's light is greater than any lights that people have made on the earth.

No lights are so strong as the sun's light. The sun lights up all of our out-of-doors, even when clouds come between the earth and the sun. The sun lights up one half of the earth all the time.

Furnaces and stoves keep our houses almost as warm in winter as they are in summer. But none of these can take the place of the sun.

"B-r-r," said Mrs. Davis. "Who left this window open? We cannot heat the out-of-doors." The furnace could not warm the room when the window was open. Look to see how cold the room was when the window was left open





Byrd Antarctic Expedition

This picture shows the snow and ice in the lands around the south pole.

The long dark weeks of winter make these lands cold indeed

Furnaces and stoves have not heat enough to warm the whole out-of-doors. We do not keep our windows wide open on cold days. An open window can soon let out almost all the heat that the furnace or stove has given to the rooms. A stove or a furnace, which heats a house, is a fine thing. But how much greater is the sun, which warms half the whole earth at a time!

There is no place on the earth where the sun does not shine at some time during the year. Even the coldest parts of the earth are warmed by the sun.



De Cou, from Galloway

This is a summer day in the Far North. Even on warm summer days these people need to wear warm clothes

The earth's coldest lands are around the north pole and around the south pole. Snow and ice stay there all the year round. Yet the sun gives great heat even to those freezing places.

For many weeks out of every year, the sun shines there day and night. It pours and pours heat into the ice and snow. Why do they not melt away, so that the land can become a warm, comfortable place? This is why :

For many long weeks in winter the sun does not

shine there at all. During this time these places do not have the heat of the sun. All is darkness and cold.

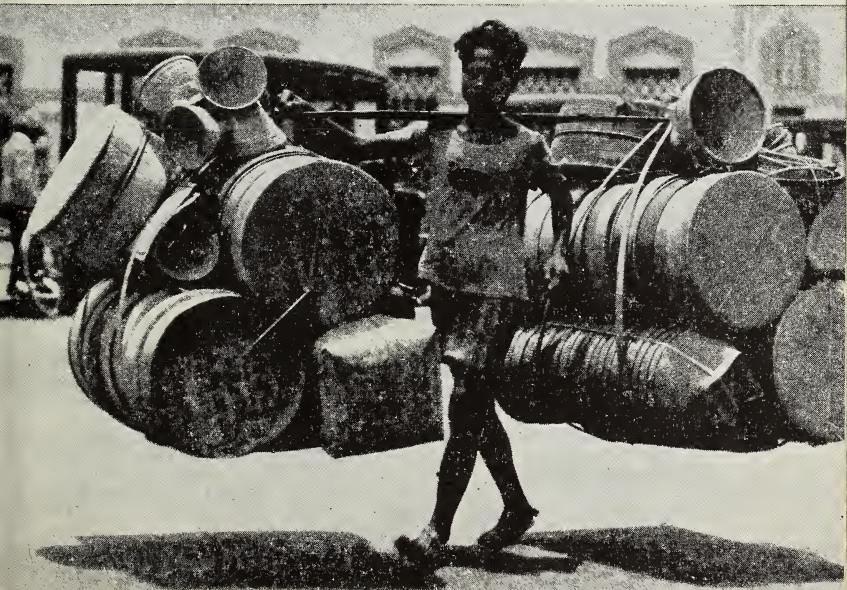
Cold winds blow most of the time. There is much snow and ice. Even the months of sunlight are not enough time in which to melt it all. The air cannot become very warm. The melting ice and snow use up much of the heat which the sun gives that part of the earth during the summer months.

There are so many weeks of darkness during the winter that the lands near the poles are freezing

This is a winter day in one of the hot countries of the earth.

The sun is high overhead. The shadows are very short. Read to see how hot these countries can be

Gendreau



cold all the year round. These places might be too cold for anyone to live in at all. But the sun shines and sends out heat most of the time during the light months of the year. This gives these cold places enough heat so that people can go on living there.

Suppose that there could be one place on the earth which the sun's rays could not reach. All the furnaces, stoves, and electric heaters in the world could not give off enough heat to warm such a spot.

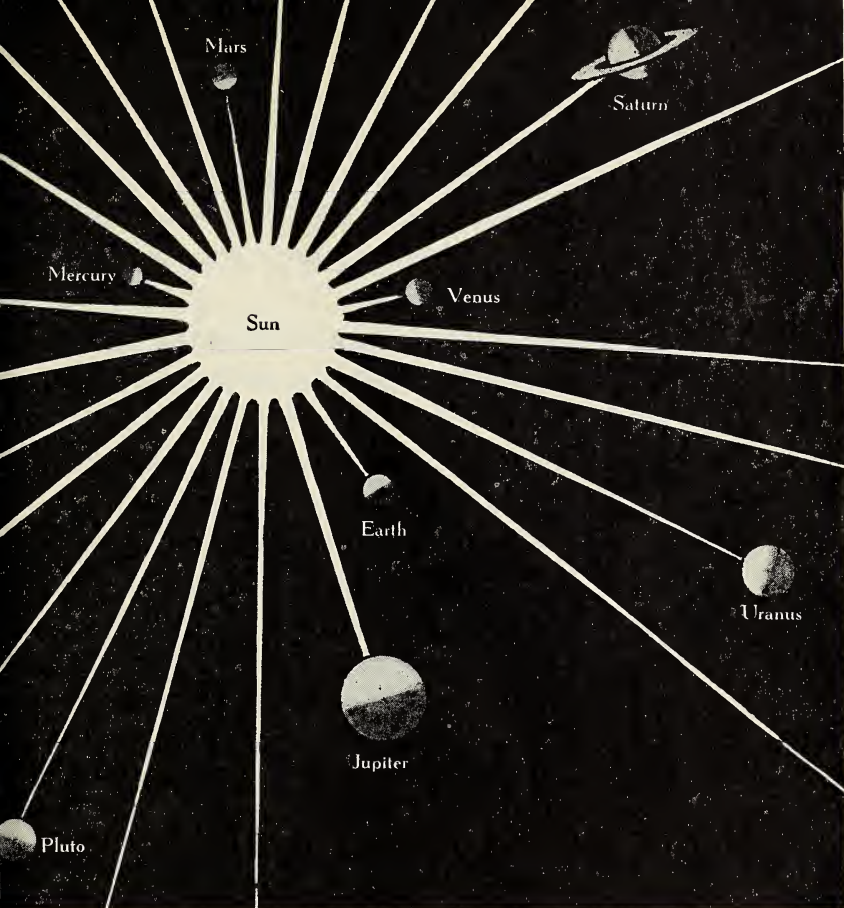
On the other hand, there are parts of the earth which are very hot. In these places, the sun shines hot every day, winter and summer.

In the hottest part of the day, the sun seems to burn the earth like fire. The ground is so hot that it burns the feet. Many things on which the sun has been shining are too hot to touch.

It is so hot that most people cannot move about in the noon sunlight without becoming sick. At night, however, many of these places are cool and comfortable.

While we are thinking about the sun's great light and heat we must remember this :

The earth receives only a very small part of the sun's light and heat. Some of it goes to the moon. Much of the sun's light goes to the stars. Much of the light and heat goes on and on and on and never reaches anything.



The earth receives only a small part of the sun's heat and light

Here is a picture to show how this is true.

It is a good thing for us that all of the sun's heat and light does not reach the earth. Suppose that all of it could come to the earth for five minutes. Do

you know what would happen? In less than five minutes everything on the daylight side of the earth would be burned up. Nothing would be left. Perhaps even the earth itself would melt. It is a good thing that only a small part of the sun's great heat and light reaches the earth.

So you see the sun is the greatest heater as well as the greatest lighter that the earth has. What should we do without the sun's heat and light?

The Sun Gives Us Color

On rainy days people say, "What a dark, gray day!"

When clouds cover the sun, the whole world seems dark and gray. The sky is gray. The water in the rivers and lakes looks gray or muddy. The grass is a dark green. Color seems to go out of many of the flowers.

As the sun shines out more brightly, the colors become more bright. Red and yellow leaves, flowers in the garden, vegetables in the market, orange and green taxis—all sing their colors to the sunny world. The world is full of color, because the sunlight is full of color.

The sunlight has many colors in it. These colors can be separated from one another. Often we can see the red, orange, yellow, green, blue, and violet, each by itself, in the sunlight.

FINDING COLORS IN SUNLIGHT

Drops of water separate colors of sunlight. They make a rainbow. After the rain, we often see a rainbow shining across the sky.

When grass is being watered in the summer time, a little rainbow sometimes can be seen in the drops

which fall. We often see a little rainbow in a glass of water where the top of the water touches the glass. Have you found other rainbows? Where were they?

The colors of the sunshine can be separated by means of a glass prism. When you look through a prism, everything you see has an edge of color. People, houses, trees, chairs, clocks, tables, all look beautiful when you see them through a prism. They are edged with lines of red, orange, yellow, green, blue, and violet.

Hang a prism in the window. When the sun shines through it, red, orange, yellow, green, blue, and violet dance on the wall. In these colors we can make ourselves see flower gardens, bright-colored birds, colored balloons—everything in the world whose color we love. The colors of all these things are shown in the colors which the prism throws on the wall.

Many other things are like prisms. The edge of the driver's mirror on an automobile shows rainbow colors. A glass bowl sometimes has rainbows in its edges. These edges are like prisms. They separate the sunlight into its different colors. What other things have you seen which are like prisms?

WHAT COLOR REALLY IS

Mary has a pretty bright-blue dress. What makes her dress look blue? Why are not all dresses blue? This is why:

Color comes from the light of the sun. When you look at one color, you see only a part of the sun's colors. Although the sun gives all its colors to Mary's dress, the cloth gives back only one. It holds all the rest of the colors. Mary's blue dress holds the red, orange, yellow, green, and violet and gives back to us only blue. So we say, "Mary's dress is blue."

Alice's red dress keeps the orange, yellow, green, blue, and violet and gives back the red of the sun's rays. So we say, "Alice's dress is red."

Grass looks green to us because the green in the sun's light is reflected back to us by the grass. A bluebell looks blue to us because the flower keeps all the colors but blue. It throws the blue back to us.

Why does a buttercup look yellow? Why does an orange look orange? Why does a violet look violet?

When all colors are put together they make white. Bill's white shirt looks white to us because it throws back almost all of the sun's colors. It holds very little color in itself.

Snow that has just fallen is the whitest thing we can find. On sunny days we want to shut our eyes

or cover our faces when we look at the snow. Sometimes people cannot see at all after they have looked a long time at wide fields of white snow. The snow throws back to us all of the sun's colors together. It is hard for our eyes to look at all this at once. Many people wear dark glasses when they must look at snow for a long time.

Quite a different thing is true of black. Black is no color. Things which are black give back none of the color which they get from the sun's light. A black coat and a black hat look black to us because they hold all of the sun's colors. No color is given back to us.

When we look around in the dark night, we see no colors at all. Everything looks black or gray. The green leaves on the trees are black. The walls are gray. Mary's blue dress looks black. Alice's red dress looks black. Everything looks black or gray because the sunlight, with its colors, is gone.

THINGS TO DO

1. Make believe that you are in a beautiful garden at night when the moon and stars are shining. These flowers are growing in the garden:

white roses

white lilies

red roses

daisies

yellow lilies

white peonies

purple lilies

red peonies

Make believe that you are going to gather some flowers. Which of these could you see to pick most easily? Why?

2. Perhaps your teacher will give you some colored papers to take home. Leave them near the window as you watch day turn into night.

Which is the first color to look black or gray?

Which colors can you see best as the darkness begins to come?

Which color shows longer than any of the rest?

3. Draw a picture of your house. Color it as it would look through a prism.

4. Make a picture of your street or yard as it looks in the daytime and then as it looks at night.

The Sun Gives Us Food

The sun helps to give us food.

It helps plants and animals to grow.

Let us see if we can show that the sun does these two things for us.

Here is a good breakfast for boys and girls :

Orange juice
Cereal

Soft-boiled egg

Buttered toast
Milk

Can you tell how the sun can give you this good breakfast?

HOW THE SUN GIVES US FOOD

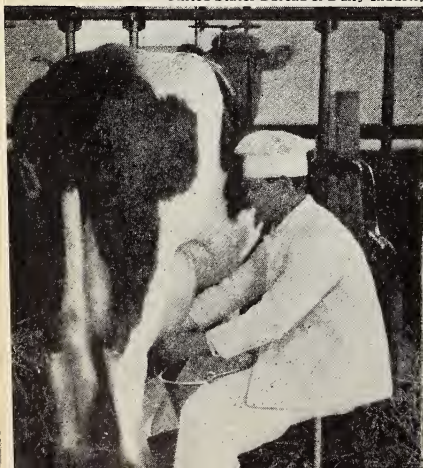
Of course we all know that the storekeeper and the milkman helped to bring us this breakfast.

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Farmers send milk and eggs for your breakfast

United States Bureau of Dairy Industry

Roberts



The sun helped to give
this good breakfast

The farmers,
too, helped to
bring it to us.
Long before
this breakfast
reached us, one
farmer had fed

and milked the cows. Another had cared for the
hens which laid the eggs. Still another farmer
had grown the wheat which made the flour for
the bread. A farmer in a warm part of the
country had watched over the trees on which the
oranges grew.

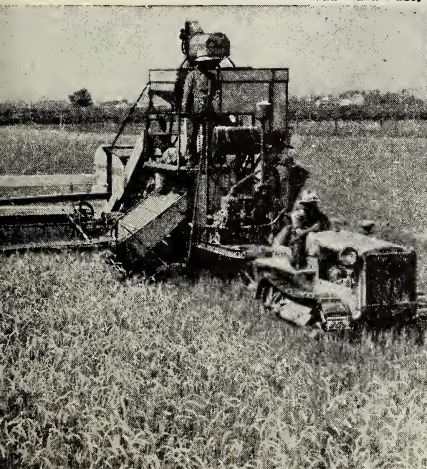


Doris Day

57

The sun helps to make the wheat grow

Kaufmann-Fabry



It helps to make juicy oranges grow

Gendreau



Now what does the sun have to do with any of this?

The cows were able to give good milk because they ate plenty of grass and grain. The hens were able to lay fine eggs because they ate grain and grass.

The grass and grain needed sunlight to make them grow. The sun made the orange trees grow. You would have had no breakfast to eat if there had been no sun. The sun really did give you your breakfast, did it not?

The cows and hens had food from the plants to make them grow. All animals get their food from plants in one way or another. If they themselves do not eat plant food, they eat other animals which do eat plant food.

The sun makes the plant food grow. Our food may be animal food or it may be plant food. But the sun is needed to make it, just the same.

WHERE DO PLANTS GET THEIR FOOD?

Can you think of anything which does not need food to make it grow?

Plants are like everything else. They need to have food to make them grow. But where do they get their food?

The farmer gives grain and hay to his cows. Sometimes he turns them out in a pasture where they can eat grass all day. He feeds his hens corn and other grain, or lets them run around to pick up grass, seeds, leaves, or insects.

All animals have food ready-made for them. But who brings food to plants?

They are given water sometimes. But plants as well as animals need more than water to make them grow. People do not feed plants as they do animals. A plant cannot travel around and find food for itself as a cat hunts for mice or birds.

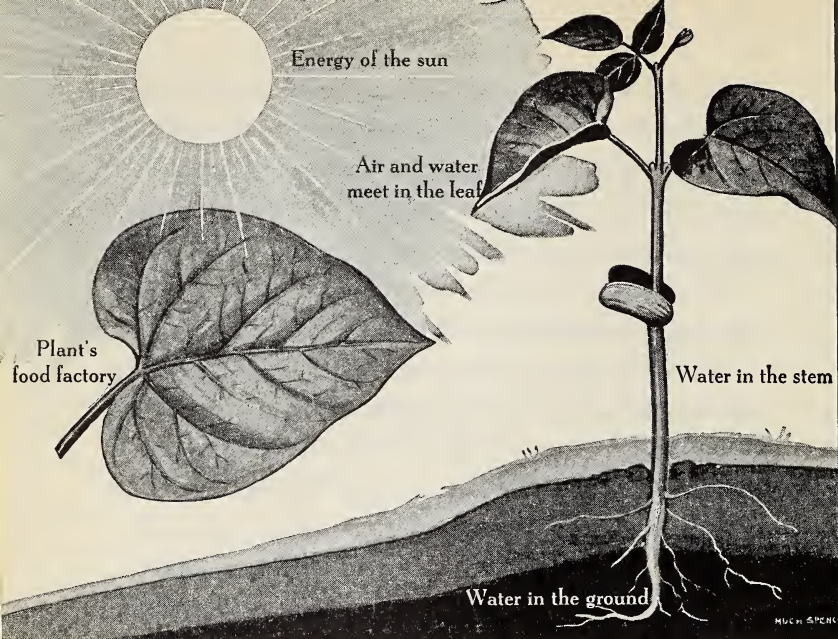
Three guesses where plants do get their food:

1. From the ground? *Partly right.*
2. From the water? *Partly right.*
3. Plants make their own food? *Right!*

EVERY PLANT IS ITS OWN FACTORY

Only plants have to make their own food. Every other living thing has food ready-made for it.

Of course many things are done to get food ready for us to eat. But suppose you should be asked to *make* some potatoes for dinner. How could a potato be made? What should you put together to make a potato? Of course no one could *make* a potato. It



This picture will help you to understand how a plant's food is made.

Begin at the bottom of the picture and read up

is not hard to grow potatoes, but no one has ever really *made* one.

A plant's food cannot be found already made. The plant must make its own food in its own food factory.

The plant gets some of the things for its food from the ground in which it grows. These are water, iron, and several other things.

You never could guess where the rest of the things for plant food are kept. They are kept in the air!

The roots of the plant take up the water, which holds the iron and other things to be used. This water goes through the stem to the leaves. In the leaves the water meets the air, and the water and part of the air come together. Here plant food is made. This is the way the plant's food factory works. It sounds very easy. But only plants have ever been able to make food in this way.

The energy of the sun helps the air and the water come together. *Energy* is a big word. Do you know what it means? *Energy* means "power."

If you have power, or energy, you are very strong. You can work and play a long time without getting tired.

Electric power makes machines run. Electric power is electric energy.

The sun has power, or energy. The sun's power, or energy, makes the water and part of the air come together. They come together in the leaf of the plant.

The sun gives the plants energy to grow and to make other plants like themselves. This energy does not stop with the plant. It goes on and on into everything which eats the plant.

The energy which the sun puts into plants may make you think of "The House That Jack Built."



These are the plants
the sun made

These are the boys
who ate the plants
the sun made

The energy of all people comes from the sun. The energy which Mother needs to take care of her home and children comes from the sun. The energy which Father needs to work every day for his family comes from the sun. The energy of all people comes from the sun through the food they eat.

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These are the plants
the sun made

This is the cow
which ate the plants
the sun made





These are the children
who drank the milk
that came from the cow
which ate the plants
the sun made

“The House That Jack Built”

THINGS TO DO

1. Here is another part to “The House That Jack Built” story of food:

Here is the grass the sun made.

Here are the hens that ate the grass the sun made.

Here are the children who ate the eggs laid by the
hens that ate the grass the sun made.

2. See if you can make up other parts for this story.
Draw pictures of your story.

3. Can you draw a picture of a plant, showing how
water is drawn from the ground to the leaves of the
plant? Show that the water and a part of the air come
together in the leaves of the plant. Do not forget that
the leaf factory does this with the help of the sun.



Plants and Animals of Long Ago

THE YOUNG EARTH

THE COAL AGE

THE AGE OF REPTILES

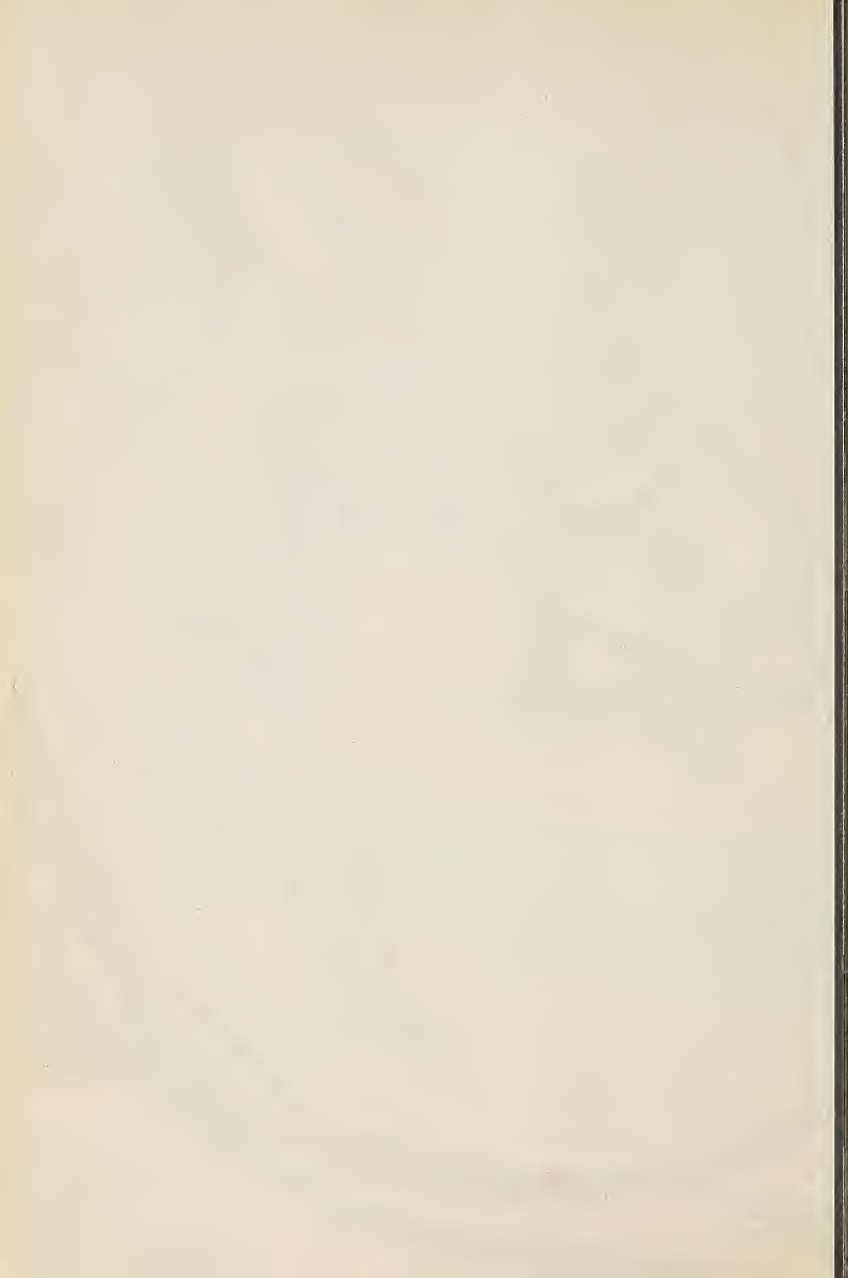
THE AGE OF BIRDS AND MAMMALS

WHAT ARE EXTINCT ANIMALS?

WHAT ARE FOSSILS?

WHY DO ANIMALS BECOME EXTINCT?





PERHAPS you think that the greatest changes which have taken place on the earth are changes which people have made.

People build towns and cities. They cut down forests. They send water for hundreds of miles to places where they need more water.

These are great changes indeed. But the greatest changes are not those which people have made.

Some of our hot, dry desert places were once cool and shady forests. Some of our meadows were once at the bottom of lakes.

Some of our fine farms were once covered with a sheet of ice over a thousand feet thick. Cold places around the north pole were once warm enough for ferns to grow as tall as trees. Many places where mountains now reach up into the sky were once low and flat like a floor.

Such changes take place very slowly. During any one of them hundreds and thousands of years passed by.

Such changes are taking place on the earth right now. They take place so slowly that many people do not know they are happening at all.

The Young Earth

“What was the earth like in the beginning?”

Many children ask this question. Probably you have asked it too. Scientists have made a number of answers to this question. Here is the answer which most scientists make today:

Long, long ago the earth was not a hard ball. It was made up of gases, as the sun is. It was a part of the sun's gases. It was a part of the sun.

“How was the earth taken away from the sun?”

Scientists have given a number of answers to this question, too. Here is the answer which some scientists have made:

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The star which came close to our sun





The gases formed into hard balls

Long, long ago another great star came close to the sun. It came very close to the sun, but it did not touch it. However, it came so close that hot gases were pulled away from the sun.

The great star moved on past the sun. The hot gases moved through the sky. They moved on a path of their own. They did not fall back into the sun. They stayed away from the sun.

Then they formed into a number of great balls. One of these great balls became what we now call the earth.

These scientists go on to say that when the earth first became a hard ball, it was not at all the way



Field Museum of Natural History (From a painting by Charles R. Knight)

Without plants or animals, the earth was a bare and lonely place

it is now. For ages and ages it was a lonely place indeed. No people lived here then. There were no animals. There were no trees or grass or plants of any kind. There were no rivers or lakes or oceans. Not even a covering of soil was spread over the young earth. For a great many years the earth was bare rock. There was no water on it. No air such as we have today was around it.

Plants could not grow without air, water, and soil. So, of course, there were no plants. Animals could not live without the plants for food. So there were no animals.

Years upon years were needed for the air and water to form. Still more years were needed for soil to gather on the outside of the earth. Yet more

years went by before plants, lakes, rivers, and oceans had covered the earth and made it beautiful. After this time, many animals were living on the land and in the waters of the earth.

The first plants were the tiniest kinds of plants. The first animals were the tiniest kinds of animals. They were so small and so much alike that it would be hard to tell which were the plants and which were the animals. Some plants and animals as small as these are living on the earth today. They are so small that they can be seen only when many of them are growing together. Many of them are so small that they can be seen only with a strong microscope.

More years passed by. By this time, many of the kinds of plants and animals were much larger. You could easily tell which were plants and which were animals. There were many different kinds of plants and many different kinds of animals. Plants and animals were living far and wide over the earth.

At last some of the plants became giant plants. Some of the animals became giant animals.

Very, very slowly great changes took place upon the earth.

This is the way some of the earth's tiniest plants look through a strong microscope. The earliest plants were something like this



The Coal Age

Long ago, when the earth was young, very many giant plants grew on it. In those days, the earth held great forests of beautiful dark-green ferns. They were as tall as some of our largest trees. They grew in many parts of the earth. They grew far north in places where now snow and ice are found all through the year. Nearly all the earth was warm then.

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A swampy forest of today. Many, many years from now

these trees may be changed into coal





© Field Museum of Natural History

A swampy forest of the Coal Age. Where these plants grew,
so many, many years ago, we now have beds of coal

The world was beautiful, but very strange. It seemed to be all one color—green. No bright-colored flowers grew in the forests. No red apples or bright berries grew on trees or bushes. No butterflies hurried through the grasses on their colored wings. No bright-colored birds flew busily about building their nests or sang their songs at evening. A few insects lived on the earth. No other animals walked about.

There were few sounds in the great fern forests. The wind and rain, the call of a few insects, and sometimes a falling tree gave most of the sounds in these early times. Everything else was very still.

Slowly these giant plants died. Today we have no ferns so large as these old, giant ferns. They fell down into the soft, swampy earth and were slowly covered over by the mud and water.

For a long, long time these great ferns lay in the earth. More soil formed on top of them and pushed them down, harder and harder. Very slowly they turned into what we now call coal. The time of the great fern forests is called the Coal Age.

THINGS TO DO

Take several pieces of soft coal. Look at them closely in a good light. See if you can find places which look like leaves or other parts of plants which grew long ago.

The Age of Reptiles

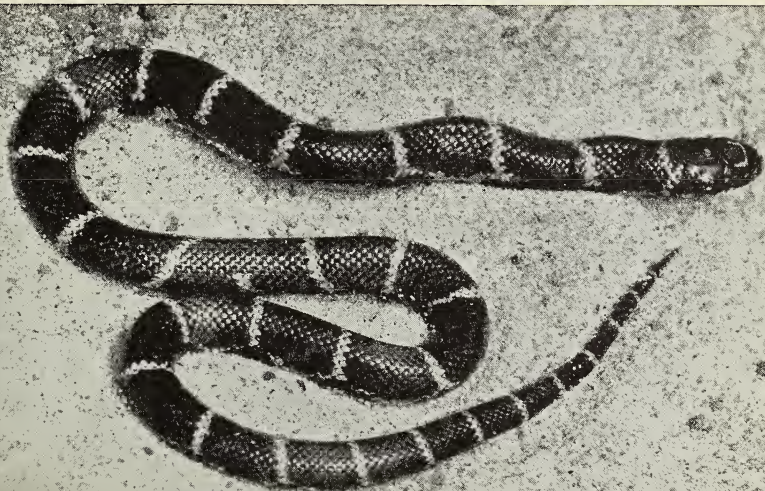
After the Coal Age, came a time which is called the Age of Reptiles. Many kinds of reptiles are living on the earth today. Snakes, turtles, alligators, and lizards are reptiles.

Reptiles do not have any feathers or fur. Some reptiles have a hard skin. Some are covered with scales. Some are covered with bony plates.

Snakes are covered with a hard skin that does not wear away easily as they crawl over the ground. Turtles have shells. Their legs are covered with a hard skin. The skin on the legs of some turtles is covered with small scales. Alligators are covered with thick, hard scales and bony plates.

A snake is a reptile. It is covered with scales. It has no legs

American Museum of Natural History





Lynwood Chace

Turtles are reptiles. They are covered with bony plates
which form a shell. Turtles have legs

Some reptiles have legs. Others have no legs. Turtles, alligators, and lizards have legs. Snakes have no legs.

Reptiles are cold-blooded animals. Do you know what is meant by a cold-blooded animal? Dogs and cats and many other animals are warm-blooded. Their bodies stay warm whether they are in a warm place or a cold place. The bodies of cold-blooded animals are about as cold or warm as the water or air in which they are living. Fish are cold-blooded animals. Did you ever catch a fish? It is as cold as the water. Do you remember how cold it felt?

Although the Age of Reptiles followed the Coal Age, still the Age of Reptiles was very long ago. At that time other kinds of animals were living in many parts of the earth, but the reptiles were the greatest and the strongest.

The reptiles of those days were not the snakes, turtles, and lizards of our time. Strange reptiles called dinosaurs moved over the earth at that time.

There were many kinds of dinosaurs. Some were bigger than elephants. Some were smaller than squirrels.

Some of the dinosaurs flew through the air. They are called flying reptiles. Some of these were as small as robins. Some were larger than any bird that flies today.

A lizard is a reptile. It is covered with a hard skin. A lizard has legs

National Park Service



Some of the dinosaurs lived in the sea, lakes, and rivers. They fed upon plants and small fish that lived in these waters.

Some of the largest of the dinosaurs are called thundering reptiles. They have been named thundering reptiles because anything so heavy would probably shake the ground if it walked about on land. Many of them weighed over forty tons. That is more than five hundred men would weigh. The thundering reptiles weighed more than our largest trucks.

These dinosaurs had long, heavy bodies and long, thick tails. Some of them measured more than sixty feet from their heads to the end of their tails. That is longer than the great busses which travel across the country. It is longer than our largest trucks.

The thundering reptiles lived in swamps. Their food grew near the water's edge. Most of the time they stayed in the water. They were too heavy to walk about easily on land. The thundering reptiles were partly held up by the water as they walked about on the bottom. Do you remember how light your body feels when you walk about in deep water?

The legs of the thundering reptiles were much longer and larger than those of the elephants that you see in the circus. Their necks were much longer than those of giraffes. Their long legs and their long



A. M. N. H. (From a painting by Charles R. Knight)

The thundering reptile lived long ago in swamps

necks helped them to reach the trees, bushes, and tall grasses which grew around the water. Their necks were very thick as well as very long. Their heads were tiny for such great animals. They were no bigger than the end of the neck. The heads were not used for fighting. The eyes were small. The mouth was wide. The teeth were large and flat.

They did not kill other animals, because they did not need their meat for food. They were too slow to do much fighting, even if they needed to. They were likely to be killed by other dinosaurs, because they did not know how to fight.

Another dinosaur was the three-horned face. It was an ugly-looking reptile. It looked like a fighter.

It had a thick, short neck like an elephant's. Around its neck was a bony collar which stood out around the back of the head.

This dinosaur had three horns. On the top of its head were two long horns. A shorter horn was on its nose. Its mouth ended in a short, sharp bill like that of a great bird. You do not have to be told why this kind of dinosaur is called the three-horned face.

Its head looks as if it were well made for fighting, killing, and eating other animals. The bony collar could have protected the neck from the teeth and claws of enemies.

The three-horned face might have been able to fight if it needed to. But it did not kill other animals for food. It ate twigs, grasses, leaves, and other plants instead. The strong, pointed bill that was part of its mouth was a great help in getting food. It helped in breaking off thick hard grasses or the woody twigs of low bushes. The back teeth were well made for eating the hard food. Something very strange and very useful happened to its back teeth. The teeth became worn down by eating hard food. Then they were pushed out of the way by new teeth which took their place. The three-horned face had many, many new sets of teeth during a lifetime.

Another family of the dinosaurs had great, strong tails and stood on their two back legs only. Their back legs were large and strong. Their front legs were very small, with strong, sharp claws by which they caught and held their food. Their heads were large. They had long, thick, sharp teeth. They ate other animals. The name for these is the leaping reptile.

Another dinosaur, which looked much like the leaping reptile, is called the tyrant reptile. He was larger than most of the others. He had a great mouth, sharp teeth, and claws. He was an ugly fighter.

There were many other kinds of dinosaurs. Some of them were small and some were very large. Not all of these kinds of dinosaurs lived at the same time. Some kinds were dead and gone when other kinds began to live on the earth.

Bones of most of these strange animals have been placed in museums. When you look at them, you feel like the little girl who said, "That animal is so funny looking, it seems as if it couldn't be an animal."

If you should travel all over the world, you would not find one of these animals alive today. No man has seen a live one. No man has ever seen dinosaurs eating trees and grasses. No man has seen them

walking about in the swamp lands looking for water plants to eat. These times were ages and ages before the earliest people were living.

THINGS TO DO

Make a picture of the Age of Reptiles. What shall you need to put into this picture?

Of course you will make some of the large dinosaurs. You might have a fight between a tyrant reptile and a three-horned face. Perhaps other kinds of dinosaurs would be watching the fight. Do not forget that some of the dinosaurs flew through the air, and some swam in the water. Some dinosaurs were large, and some were small.

You will need to have trees in your picture. Many of the trees of that time looked something like our palm trees. Near the water, grew a giant plant which was very much like the small weed we now call horsetail, and which grows in swamps and meadows.

THINGS TO THINK ABOUT

Perhaps, ages ago, dinosaurs lived in the very place where you live now. Perhaps they went about your land looking for food.

How different the place is now from the way it was in those old times when the dinosaurs lived! The plants are different. The animals are different. Great changes have been made by people.

Perhaps great changes have taken place in the land itself. Try to find out about some of these changes.

The Age of Birds and Mammals

For many more years, the reptiles were the great animals of the world. During a part of this time, animals of different kinds began to live on the earth.

Among these new kinds of animals were birds. Up to this time, there had been no birds.

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Flying reptiles and the earliest birds.

Read to see which are the reptiles and which are the birds

© Field Museum of Natural History (From a painting by Charles R. Knight)



You have read that some of the dinosaurs could fly. These flying dinosaurs were not birds. They were reptiles. They were cold-blooded animals. They were covered with a hard skin. They had no feathers.

The earliest birds were quite different from the flying reptiles which lived about the same time. The birds were warm-blooded animals. They had some feathers. All were about the same size. They were about the size of crows or pigeons. You remember that some of the flying reptiles were very small and others were very, very large.

These earliest birds would seem very strange if they could be seen flying about today. They were not covered with feathers, as most birds are today. They had feathers only on their wings and tails or a few on their backs. They had many teeth but no bills.

In one way these early birds were like both the flying reptiles and the birds of today. They laid eggs.

About this time, another new kind of animal began to live on the earth. These animals did not fly through the air. They walked about on the ground. They were warm-blooded animals. They were covered with coats of hair or fur which kept them warm. They did not lay eggs. They were not reptiles or birds. These animals are called mammals.



© American Museum of Natural History (From a painting by Charles R. Knight)

These are early horses. How are they different from horses of today?

Cows, horses, sheep, cats, pigs, giraffes, elephants, camels, skunks, bears, and many other such animals are some of the mammals of today. In this next age, we hear about the first animals of this kind. It is called the Age of Mammals.

Among these early mammals were the grandfathers of many kinds of mammals which we find on earth today. At first they were very small. Think of horses the size of small dogs, camels the size of cats, and elephants no larger than sheep! If the giant dinosaurs had been out of the way, the world of that time would seem to us like a big toy shop.



American Museum of Natural History (From a painting by Charles R. Knight)

Grandfather to the elephants of today. He is called a mammoth

These new animals did not stay small, however. As the ages went by, they became larger and larger. The horses went through a number of changes. At one time they had four toes. Later they had only three. Their feet were not hard hoofs, as they are now. After many more ages the horse and camel grandfathers became as large as they are today.

The elephant grandfathers went through very great changes. These mammals, once no larger than sheep, became great animals called mammoths. The mammoths were almost as large as the elephants of

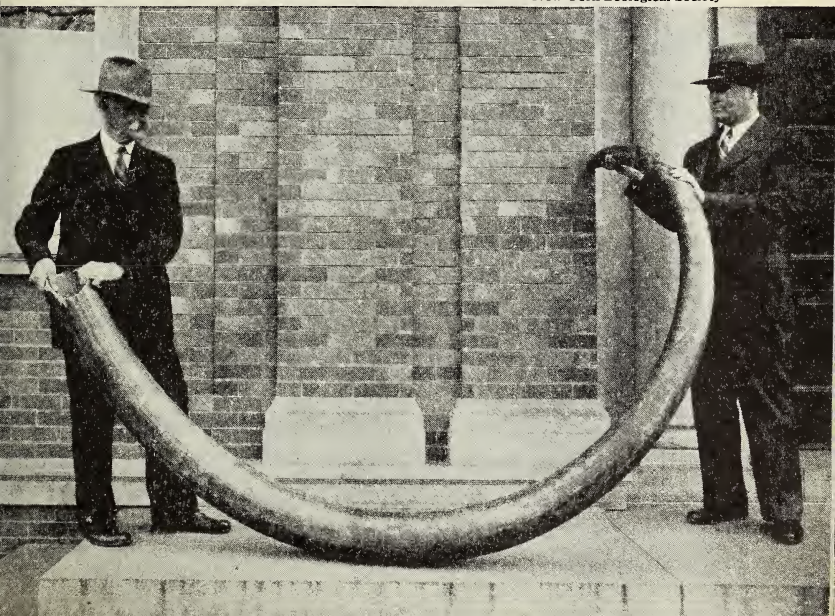
today. They were covered with long, thick hair. Their tusks were sometimes ten and a half feet long. These tusks often weighed as much as one hundred and seventy pounds. The mammoths lived in nearly all parts of North America and in other countries in the north. They were very strong and were able to live through storms and freezing weather.

Elephants of today look very much like the old mammoths, but they are different in many ways. They are covered with thick skin instead of hair. They are not found in cold places, like those in

These men are holding a tusk of an old mammoth.

How very large the mammoth must have been

New York Zoological Society



which the mammoths used to live. They are found only in the warm forests of India and Africa.

None of the mammoths are alive today. If you want to see a mammoth, you will have to go to a museum. People of today have never seen living mammoths. The mammoths in the museums have been dead for thousands of years.

It is true that no people of any time have ever seen living dinosaurs. But many people were living in the world when the mammoths were alive. These early people were afraid of the mammoths. They hunted them, and often killed them. They used the mammoth meat for food. They made knives and axes of its bones and tusks.

We know that people were living on the earth during the time of the mammoths. Men have found pictures of mammoths drawn on the rocks. These rocks were the walls of caves, and the pictures were drawn by the people who made their homes in these caves. They must have seen live mammoths, or they could not have drawn these pictures.

People are mammals. You are a mammal, and so are all your friends. People were probably the last kind of mammal to begin life on the earth.

What Are Extinct Animals?

The children in Miss Smith's class were visiting the museum. They wanted to see the dinosaur bones and the bones of other early animals. Mr. Green worked at the museum. He was helping the children to learn about these animals.

"Once upon a time," Mr. Green said, "there lived on the earth many kinds of animals which will never be seen again. These animals are now extinct.

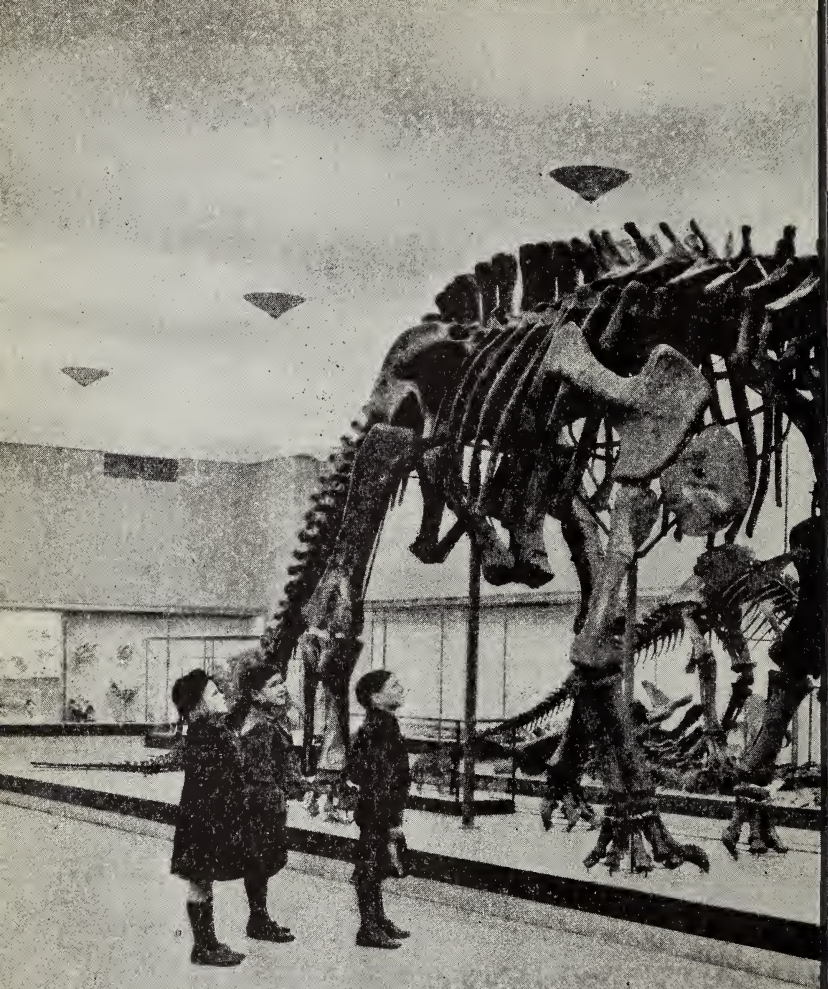
"Long before the mammals became so large and strong, the dinosaurs were extinct."

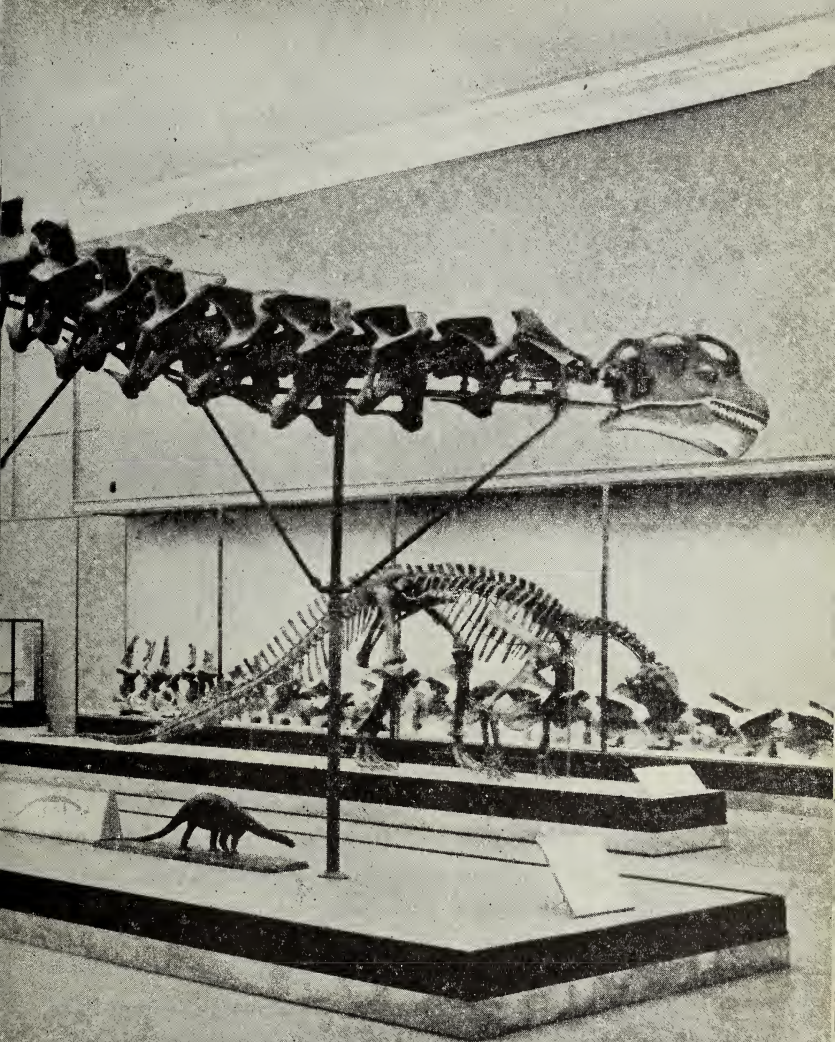
The boys and girls were not sure that they knew the meaning of the word *extinct*. So they asked Mr. Green.

Bob said, "If my dog should die, would he be an extinct animal?"

"No," said Mr. Green. "When we say that an animal or plant is extinct, we mean that that kind of animal cannot be found living anywhere on the earth today.

"If your dog should die, we should not say that dogs are extinct. Many more dogs would be left in the world. There will be plenty of dogs for a long, long time to come. However, if something should happen so that all the dogs in the world should die, then we should say that dogs were extinct."





No dinosaurs are living anywhere in the world today. Dinosaurs are extinct. Elephants are living in the world today. But no elephants of the kind which are called mammoths are living in the world today. Mammoths have become extinct.

Because some kinds of plants and animals are large and strong, do not think that they never will become extinct. The treelike ferns of the Coal Age, the dinosaurs, the mammoths, all were among the greatest of living things. Yet none of them are here now. They are all extinct. The mammoths were the youngest of these old giants. They became extinct a great many years ago.

THINGS TO THINK ABOUT

People have made some animals nearly extinct. They have hunted and killed many more than they should. Reindeer and buffalo have been hunted and killed until they were almost extinct.

Now laws have been made to protect these wild animals and many others. People are trying to keep the reindeer and buffalo and other animals alive. Large numbers of them are now living in places where they are given good care. They have been saved from becoming extinct for a long time to come.

Did you ever hear anyone say that some animal is in danger of becoming extinct? Should you know, now, what this means?



American Museum of Natural History

These men are carefully taking the dinosaur bones out of the ground

What Are Fossils?

Long, long ago someone found the bones of some great animals. These bones were partly under the ground and partly on top of it. People wondered what man or what animal could have had such great bones. They knew of no living animals with bones as big as these. At last they said, "These bones must be the bones of giants who lived here long ago."

Then they made strange stories about the giants who had once lived on the earth. But after a while they had to stop believing these stories. They found that the bones were not the bones of giant men. They were the bones of giant animals.

This need not be the end of the stories. We can think of quite wonderful stories about the giant animals. But of course we can really believe only what we know to be true. We know only what the scientists are able to find out from the bones and the rocks and the clay.

As the years went by, scientists began to look for other signs of animals of long ago. They found strange footprints in rocks. These footprints were not like the footprints made by the feet of any animals living at that time. As the men learned about the rock, they found that it was very old.

"The footprints must be older than the rock," they said. "Footprints can be made only in soft places. Old animals have left their footprints in mud which later hardened into rock.

"It takes a long, long, long time for mud to harden into rock. These animals must have lived here many, many years ago."

Then they said, "At one time strange animals which are now extinct must have lived in this part of the country."

Another sign of these old great-great-grandfather animals was made in much the same way. It tells us still more about the animal. A print of the animal's whole body was found in the rocks.

Years and years ago, when the animals lay down and died, the print, or shape, of their whole body was left in the mud. This mud hardened into rock. The print of the animal's body was left in the rock. It looked the way it did when it was first made in the mud.

These prints are very helpful now. They tell us many things we want to know about what the world was like before man was here.

One of these signs alone would not tell us very much about the plants and animals of long ago. But several signs together tell us many true stories. They are as good to hear as the stories which are told about the animals of today.

Dinosaur footprints found in a rock

American Museum of Natural History



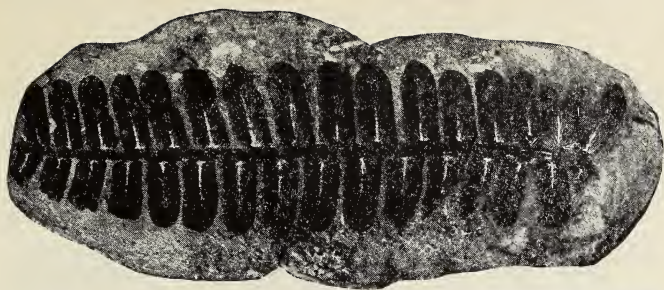
All these signs of old animals and plants are called fossils. The footprints in the stone are fossils. The prints of the animal's body in the stone are fossils. The bones are fossils.

The fossil which most of us know best and which

A record of an early animal. This is the print
of a dinosaur called the duckbill dinosaur

© W. M. Richards & Co.





Walker Museum, Chicago

This print of the leaf of a fern was formed
in a large piece of coal. It is called a fossil

is most useful to everybody right now is coal. Coal, you remember, is what is left of the old giant ferns. These grew here before most of the animals were living. Coal is the oldest fossil of all.

Why Do Animals Become Extinct?

Many children ask this question after they have seen fossils or after they have read about plants or animals of long ago.

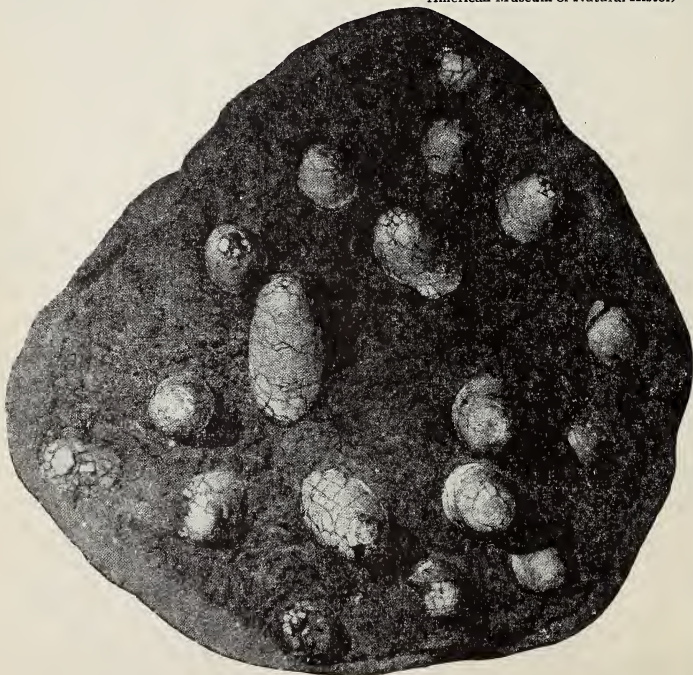
"Why are there no dinosaurs or mammoths now?"

"What has made them extinct?"

These are questions which the men at the museums are asked over and over again.

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A nest of dinosaur eggs. These eggs were laid
years ago, when the earth was young
American Museum of Natural History



Have you wondered about this, too? Have you asked about it at home? Have you tried to find the answer from pictures or from books? There are many answers to this question.

Probably no one thing made any kind of animal become extinct. Scientists believe that some of these things may have happened:

1. Perhaps the animals used to feed in swamps which dried up. Because their food dried up, they were not able to get the right kind of food. So they all died.

2. Perhaps the animals had been living in a warm country which slowly grew colder. The plants which grew there while the country was warm could not live there when it was cold. When these plants died, many animals had nothing to eat. They could not live without food, and so they died.

3. Perhaps water came over the land where there had been no water before. This would kill many animals.

4. In some places snow fell so hard and so long that the animals were covered with it. They could not climb out of the snow. This killed many of the mammoths.

5. Perhaps there was enough food for only one kind of animal. So the quickest or strongest kind of animal took the food. Perhaps these quicker and

stronger animals killed many of the rest in fights for food.

6. Perhaps some of the mammals ate the dinosaur eggs and no baby dinosaurs were born. Then there would be no young dinosaurs of that kind to take the place of the old ones when they died. That kind of dinosaur would then become extinct.

The fossils do not really tell us these things. But they make us think that such changes could have taken place. Of course these changes were made very slowly. Probably thousands of years went by while they were happening.

THINGS TO THINK ABOUT

You can see that the earth is very, very old. Most scientists say that it is millions of years old. A million years ago is a long, long time. We cannot think how long it really is. But we might try a little.

Think how long a few weeks seem when you are waiting for Christmas to come. Think how long the year is between one Christmas and the next. When you have a birthday, does your last birthday seem long, long ago? It is only one year.

Listen to the clock while it ticks for a whole minute. If it ticked once every second, it ticked sixty times while you were waiting. Did the minute seem a long, long time while the seconds were ticking themselves away?

Do you know how long it takes a clock to tick one million seconds? It takes nearly two weeks. Can you think of nearly two whole weeks of seconds? Wouldn't the time seem long if you were watching the clock every second of that time?

Now suppose that each second were one year long. What a long, long time one million years would be!

IV

Animals of Today

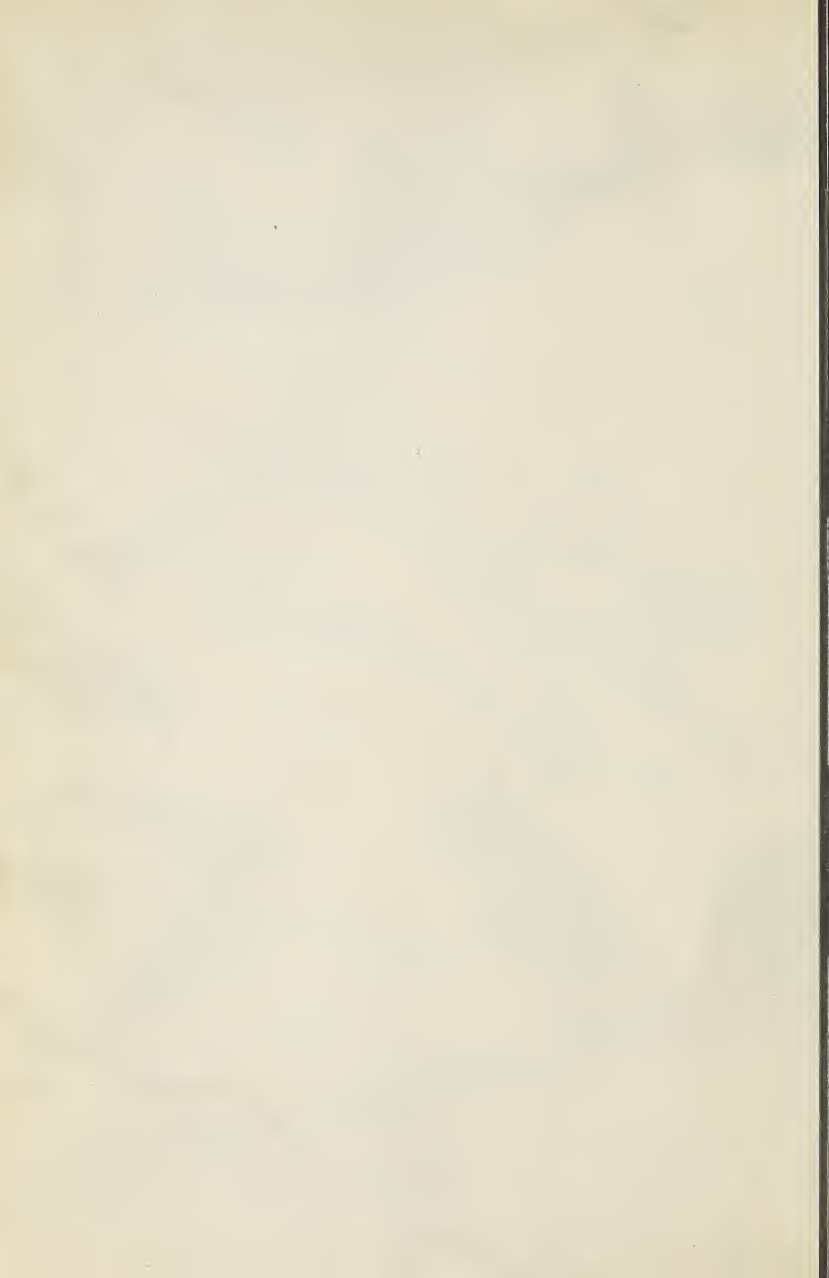
**WHAT HAPPENS TO ANIMALS WHEN
THE SEASONS CHANGE?**

HUNGER AMONG THE ANIMALS

ANIMAL ENEMIES



JACO
BATE
ABBOT



IN THE last unit you have read about many kinds of animals that used to live on the earth. None of these kinds of animals are here today. Something happened to take the lives of all of them. These animals are now extinct.

Many different kinds of animals are living on the earth today. Lions, tigers, giraffes, zebras, cows, woodchucks, snakes, sheep, cats, bees, fish, birds, and many, many other kinds of animals are here in great numbers. Do you think they will always be found as they are today? Will any of them become extinct?

It is not so easy as it seems for animals to go on living. More animals than you can count do not live to grow up. Few wild animals ever die of old age. Danger is always in their way. The next stories tell you about some of the dangers which animals meet in their everyday lives.

But many animals do live to grow up. They are able to grow up because they are well protected against these dangers. The stories in this unit also tell you about some of the many ways in which animals are protected against harm.

THE COLORED PICTURE IS FROM A PAINTING BY JACOB ABBOTT.

What Happens to Animals When the Seasons Change?

Do you know what is meant by the change of seasons? Spring, summer, fall, and winter are the four seasons of the year in most places. When winter turns to spring, we say that the season changes. When summer turns to fall, we say that the season changes. There is a great difference between winter and summer.

In many places on the earth winter is a very cold time. There are heavy snowstorms, and the snow and ice stay on the ground for weeks or months. But

In some places winter is a cold and snowy season of the year





The short, cold days of winter change to long, hot summer days

summer is warm and pleasant and sometimes very hot. A great change takes place, too, when summer turns to winter.

In other places winter is not so cold as this. But winter is colder than summer, and people need fires to keep them warm. Snow falls only once in a while. Sometimes these winters are full of rainy days.

In some places winter is very pleasant, with plenty of warm rain. But summer is a hard, unpleasant time of year. The summers are long, hot, and very dry. Almost no rain falls. Plants become very dry, and many stop growing. Animals have a hard time to find food to eat and water to drink.



In some places winter days are cool, but snow does not lie on the ground.

There is plenty of rain, and all plants look fresh and green.

In what kind of place do you live?

Do you live in a cold part of the country? Then tell some of the things people do to live comfortably through the long, hard winter.

Do you live in a place that has hot, dry summer? Then tell some of the things people do to get along through this dry, hard time.

People have learned how to get ready for the cold winter season and for the dry summer season. But other animals cannot care for themselves in the same way that people can. Many of them lose their lives when the cold season or the dry season of the year comes around.

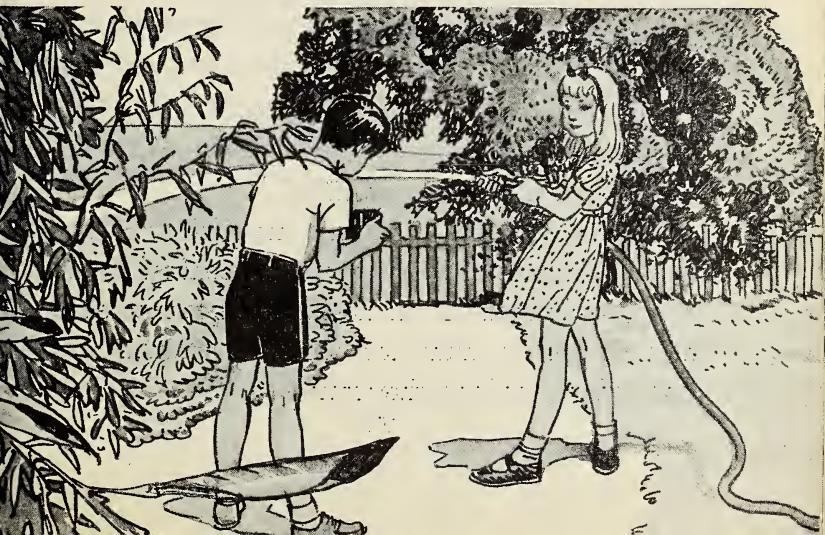
DANGERS OF COLD WINTER

Snow and Wind

Many times animals have to fight against deep snows and strong, sharp winds in winter. Sometimes sheep or other animals find themselves in open fields or meadows during a storm. There is no place for them to find shelter. When the snow falls and blows about, it covers the animals like a thick blanket. It becomes so deep that they cannot climb out of it. Sometimes these animals are held in the snow so long that they lose their lives.

Walking through the deep snow is hard work for some animals. Sometimes they become so tired that they cannot reach places where food is to be found.

Summer days are hot, dry, and dusty





Belden

These sheep have been caught in a heavy fall of snow.

Do you think they are well protected from the storm?

Sometimes ice forms on the wings of birds. This makes flying very hard work. The birds drop to the ground and often they are killed.

Wind often blows snow into high piles. Sometimes these piles of snow cover the openings to the shelters of animals. Then these animals cannot leave their shelter to hunt for food. If animals are "snowed in" too long, they starve.

Food Is Hard to Find

Food is hard to find in winter. Most of the animals which die in winter do not freeze. They die because they do not have enough to eat. Perhaps you can name some of the foods which animals have in summer but which they do not have in winter.

Fierce Enemies

Animal enemies are very watchful and fierce in winter. Most animals grow very hungry as winter goes on. An animal will fight much more fiercely when it is hungry than when it has plenty to eat.

Did you ever see anyone try to take a plate of food away from a hungry dog or cat? When this happens, the animal makes an ugly noise and often starts to fight for the food. You must never try to take food away from your dog when he is hungry. He may bite you, even though he almost always is a good dog.

A strong animal often has been known to kill an animal of its own kind which is not so strong. Sometimes both try to get the same food when there is not enough for both. Then the stronger animal kills the animal which is not so strong. His hunger makes him a fierce enemy to his own kind. Hungry wolves snap and bite at each other fiercely when they are eating an animal which they all have killed.

Of course many places on the earth do not have

the kind of winter in which snow stays on the ground for weeks and months. In some places the winter months are as warm as summer months. In these places animals have about the same ways of living in winter as they have in summer.

In other places winter is colder than summer and sometimes snow falls. In these places food is harder to find than it is in the places where summer lasts all through the year. But even here, living is much easier than it is in the places where snow covers the ground all winter. Many animals in cold, snowy parts of the world are very thin, hungry, and tired by the time the winter is gone.

HOW ANIMALS ARE PROTECTED AGAINST WINTER

Perhaps you wonder how animals are able to live through these cold months of the year. You will be glad to know that there are many ways in which they can find food. There are many ways in which they are protected from storms and other animals.

Winter Food for Animals

A number of things are left for animals to eat in winter. Bright-colored berries, seeds, unpicked fruits are good food for birds. Chickadees eat

thousands and thousands of seeds from the weeds left standing in the fields. Birds also find insects in the bark of trees. Have you ever watched a busy nuthatch running up and down a tree trunk picking insects out of the bark?

Mosses, buds, the bark of young trees, small roots and branches are eaten by other animals. Rabbits sometimes eat bark from young fruit trees. This helps the rabbits to live through the winter, but it does not help the farmer who owns the fruit trees.

Of course squirrels find many kinds of nuts.

The seeds of weeds make good food for many winter birds

Galloway



Small animals, such as mice, make food for larger animals.

Many people put food in places where birds or other animals can find it when they are hungry. Some animals come for food again and again. The food given by people helps many animals to live through the winter.

However, many winter animals take food which people do not want them to have. Farmers must

In winter, hungry deer eat the bark and buds of young trees

Black Star



watch their grain, their chickens, their vegetables, and their seeds. Mice, foxes, weasels, mink, crows, and other animals are always ready to take food from the farmers. Early in the spring, hungry deer come out of the woods to find food. They often eat the young plants which are growing in people's gardens. They even have been known to go into towns to feed in gardens there.

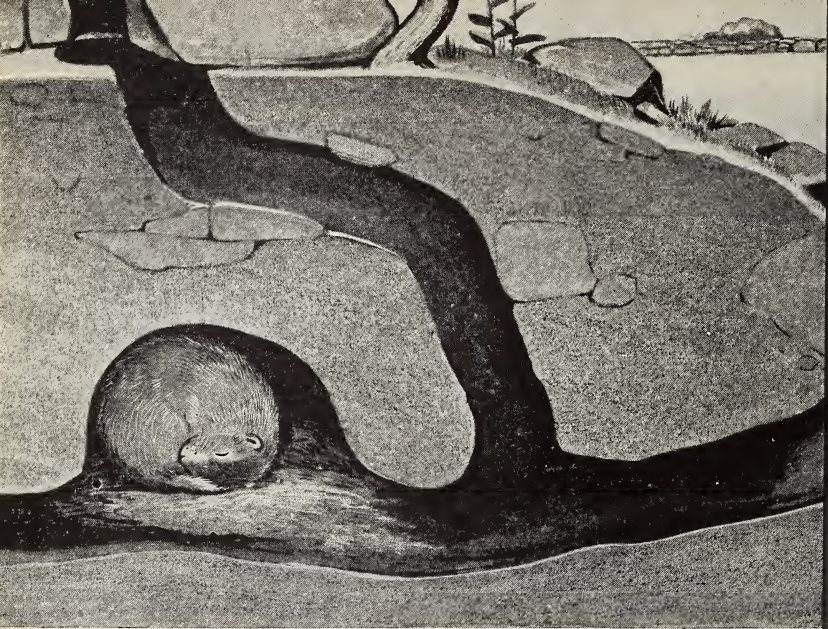
Hunger makes animals very unafraid. They go into places where they would be afraid to go if they were not so hungry.

Fewer Animals to Eat the Winter Food

Here is another thing that helps animals through the winter. Although there is less food than there is in summer, there are fewer animals to eat it. Many birds fly to the south, where there is plenty of food. Muskrats and beavers stay in houses which they have built in the water.

Many animals hibernate during the freezing cold of winter. By *hibernation* we mean "a resting time." The animals which hibernate find a dark place away from the cold winds and snow. There they take a long rest. Most animals hibernate under ground.

During this rest, or hibernation, the animal seems almost dead. It does not move. Its heart beats very



A woodchuck does not need to look for food in winter

slowly, and you can hardly see it breathe. But it is not dead. When warm days come, the animal seems very much alive. It moves about and begins to look for food.

In some places frogs and turtles spend the winter in the mud. Snakes and toads also crawl under the ground for the cold months. Woodchucks often hibernate all winter in their tunnels under the ground. Chipmunks, skunks, and bears have long resting times in the places they use for shelter.

In places where snow and ice cover the ground

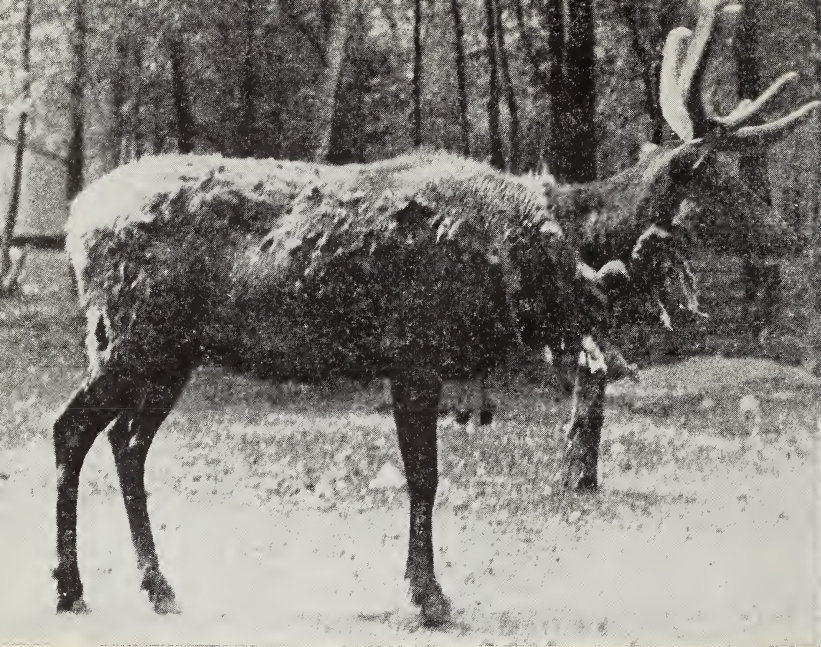
all winter, most hibernating animals stay under ground all winter long. In places where freezing cold weather lasts only a part of the time, animals hibernate for a shorter time. In places where there is very little freezing cold, animals hibernate for a very short time. In places where winter months are as warm as summer, animals do not hibernate at all.

Of course animals do not need food when they are hibernating. So their part of the winter's food can be eaten by many animals that stay above the ground.

Change of Color

The colors of most winter animals help to protect them from their enemies. It is not easy to see a white or a gray animal against the snow or against the gray earth and trees. He cannot be caught by an enemy so easily as he could be if he wore the brighter colors of summer.

Squirrels' coats change from brown to gray in winter. So do the coats of some kinds of deer and some kinds of rabbits. Some rabbits become nearly white in winter. In summer weasels' coats are a reddish brown with a stripe along the back. In winter their coats are a beautiful white. There is only a bit of black at the end of the tail. Even their name changes. In winter they are often called ermine.



Lynwood Chace

This deer is losing his thick winter coat.

The thinner, spring coat is growing under the old one

Juncos have white breasts, with smooth, dark-gray wings and heads. Their white and gray colors look like shadows on the snow. Chickadees' feathers are gray and black in winter. Watch the English sparrows during the fall. You can see that their coats change from brown to gray for the winter.

Do you know of any other animals whose color helps to keep them from being seen in the white-and-gray winter world? Look for some of these animals when you are taking a winter walk.

Warm Winter Coats

The thick coats of winter animals help to protect them during the cold winter months. Cats, dogs, horses, sheep, weasels, wolves, owls, sparrows, and other winter animals all have new coats of fur or feathers for the winter. In the fall these animals lose much of the coat they have worn all summer. The new winter coat of fur or feathers is much thicker and warmer than the summer coat.

In the spring, animals lose the greater part of their winter coats. Have you ever looked at the coat of a horse in early spring? His winter coat has been thick and shiny. In the spring, this fine coat looks like an old coat that is worn out. The coats of squirrels, rabbits, cats, dogs, owls, sparrows, and other winter animals look that way, too. The new coats are thinner than the old coats. They will be much more comfortable in summer than the thick winter coats would be.

Safety in Shelter

Most animals have some kind of shelter into which they can go from freezing weather. Birds and other small animals are safe among the thick branches of evergreen trees. Some birds and other small animals find a safe place under thick grasses or low bushes. Their hiding place may be covered



Small animals find safe hiding places in snowy weather.

How many can you find?

with deep snow, but almost always they are safe for a long time.

Rabbits crawl under low bushes, into holes in the ground, or into holes under the roots of trees.

Squirrels find shelter in all kinds of places. They build nests of sticks and leaves. You can see these nests in the branches of trees. Squirrels hide in old holes made by woodpeckers. They often find their way into the tops of people's houses. Here they have winter homes away from wind and storms.

Perhaps you think that life is very hard for the animals in winter. Perhaps you wonder how so many of them can stay alive until spring comes. Many people think as you do about this.

Although animals are protected in many ways, there are many great dangers. Only the strongest animals live through these dangers. Many of them are very, very hungry and worn out by the time spring comes. Many of them might not live much longer if winter went on and on.

But winter does not last forever. Spring always follows. Before the winter food is all gone, spring is here, with many good ways for finding new food. Freezing winds and deep snows do not take the lives of all the winter animals. Warm spring air and rains soon take the place of these great dangers. Spring saves the lives of many animals.

THINGS TO THINK ABOUT

Can you tell about other places where animals find shelter in winter? What about dogs, cats, rats, mice, horses, cows, or sheep?

In winter, deer and other wild animals often come very close to places where people are living. You can feed them. But in summer they are very wild. You can hardly find them in the woods. Can you tell why this is so?

THINGS TO DO

Take a winter walk in the fields or woods or parks. Think of the things you saw or heard there in summer. How different these places seem in winter!

Do you see as many animals as you did in summer? Do the animals seem more unafraid?

Take some nuts or seeds for the squirrels. See if they will come to you and eat out of your hand.

Take some crumbs, seeds, or fat meat for the birds. Keep very still, and see if they will come close to you to get the food.

What colors are the coats of the birds? What color are the coats of the squirrels?

See if you can find any other animal whose coat shows that it is his winter coat. How can you tell?

Do the woods, fields, or parks seem very still in the winter? What sounds do you hear in summer that you do not hear in winter?

Hunger among the Animals

HUNGRY TIMES

Spring Food

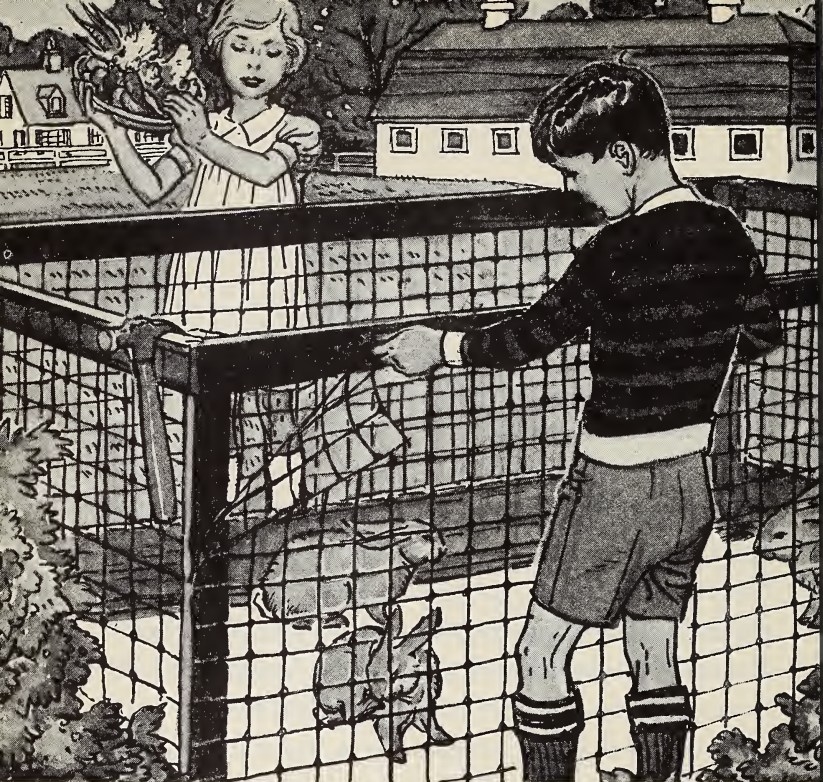
The cold, hungry days of winter are over at last. Now it seems as if life would be very easy for all animals. The spring world seems to be full of good things to eat.

Grass grows all about. Plants of all kinds are pushing their way out of the ground. Young leaves and branches are growing on the trees and bushes. Insects are coming out of the eggs. Suddenly the ground seems full of worms and insects. Hundreds of mice and other small animals are being born. It seems as if there would be enough food for all.

But a great many animals die in the warm spring and summer seasons just the same. Life is not nearly so easy as it seems. Many things happen to the food which seems so plentiful. Many things happen to take the lives of animals at this time.

More Animals to Eat Spring's Food

There is much more food in spring than there is in winter. But this does not mean that there will be enough food for all animals. Spring has more animals to eat this food than winter has.



If you have pets, you must always remember to give them food and water

Birds come back from the south. Young birds come out of the eggs.

Skunks, bears, woodchucks, chipmunks, frogs, toads, snakes, and turtles have been hibernating most of the winter. They have not eaten for a long, long time. When they come out in the spring they are as hungry as hungry can be.

Insects come out of the eggs and begin to eat plants or other insects.

Many young mammals are born in the spring.

All these animals need to eat, so that they can live. There are many, many animals to eat the food which seems to be so plentiful in spring. Is there always enough food for all the birds and mammals, reptiles and fish?

Even if there should be enough food for most of the animals in spring, many things happen to keep this food from lasting all summer.

Many kinds of insects are found only in the spring. By the end of summer many of these have died. Many are in cocoons. Some have gone into the ground. Now the animals that have been eating these insects have to look for other kinds of food.

The same thing happens to animals that have been using other kinds of young animals for food. Young birds, salamanders, mice, tadpoles, toads, and frogs are food for many, many animals.

Most animals do not have birthdays at just any time of year as people do. They usually are born in the spring. As summer goes on, these young animals become fewer and fewer. Many of them have been eaten by other animals. Some grow up and no longer can be eaten by the animals that need young animals for food.

Another thing we must remember is this: It often happens that an animal finds food for itself and then becomes food for another animal. One minute a small salamander or a young frog may be making a good meal of insects. In the very next minute he may be snapped up by the bill of a large water bird. Each animal has had a good meal. But one goes on living, while the other does not. That is the way things go in the animal world.

Dry Weather Takes Away Food

Summer often brings other trouble for animals. Spring rains may be followed by long weeks of dry weather in summer. If the dry weather lasts a long time, many animals go hungry or starve to death.

Many animals live on fresh green plants. If there is no rain, these plants often dry up and die. Other plants become so dry and hard that animals cannot eat them.

When little or no rain falls, the drinking water dries up. This makes very great trouble. Animals can go without food longer than they can go without water.

In some parts of the country, life is harder for animals in summer than it is in winter. Winters are not very cold, and there is plenty of rain. There is enough food for most winter animals.



Kirkland-Pix

farmers in the dry West dig water holes for cattle.

Life would be hard for the cattle without these water holes

But the summers are long and hot and very, very dry. Many of the animals which live in these places have a hard time in summer.

All animals must have food and water. We know that there are many reasons why animals become hungry. But we know, too, that there are many ways by which they can find food.

HOW ANIMALS ARE PROTECTED AGAINST HUNGER

How many different kinds of animals there are in the world! You would have a hard time to name them all. You would have a hard time even to count them.

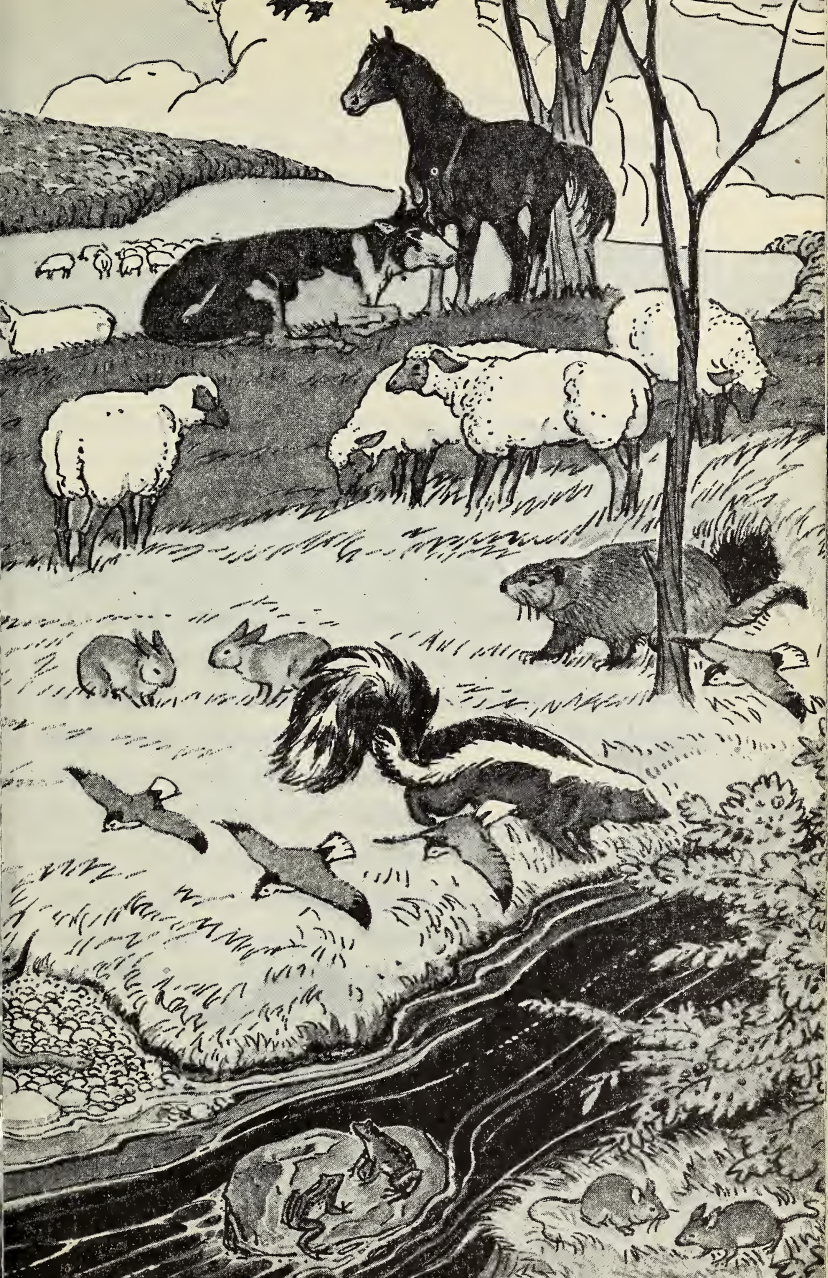
You know how hard it is for them to find food. You know that many of them do not find enough food. You know that many of them become food for other animals.

But many, many, many animals are able to get plenty of food, and they go on living year after year. There are a number of ways by which food can be made to go around among so many animals.

Animals Live in All Parts of the Earth

Did you ever stop to think that animals live in nearly every place on earth? They live in the cold places and the hot places, in wet places and dry places. They live high up in trees and in the ground. Most animals live in light, sunny places. But some animals live better in dark places.

In each of these different kinds of places some kinds of animals find the food that is best for them. It is a good thing for animals that all of them do not



need to live in the same kind of place. There would be few animals on the earth if that were true.

Different Kinds of Animals Eat Different Kinds of Food

Here is another way by which food is made to go around among many animals. Many different kinds of animals live in the same place. Since different kinds of animals eat different kinds of food, there will probably be enough food for all.

Think of some field or meadow where there is a little brook. Cows, horses, or sheep feed on the grass there. Perhaps some woodchucks have their holes in the ground. Many kinds of insects live in the grass. Skunks come there at night to catch the beetles. Near a stone wall, you may find some garter snakes or some milk snakes. In the ground, meadow mice eat the grass roots. Some of the birds eat insects. Some eat berries and larger fruits. Some live on seeds. You can catch minnows in the streams. Frogs live in low, swampy places made by the brook. Perhaps you can name many other animals which might be found there.

All of these kinds of animals can find food in so small a place because they eat many different kinds of food.

If all the animals were cows, the grass would soon be gone. The cows would starve unless they could find some other food.

If all the animals were skunks, the beetles would be eaten in no time. The skunks would starve unless they could find other food.

But since the many different kinds of animals eat many different kinds of food, there is likely to be enough food for all.

People Help Animals to Have Food

People try in a number of ways to keep animals from starving. Some countries own hundreds of miles of land where animals can live safely. Some of this land is covered with forests. Some is mostly grass land. A part of it is very dry with few plants. In these parks the animals are safe. No one may harm the animals in these places. Food is placed where the animals can reach it easily when they need it. Men are paid to keep food in places where the animals can find it and eat it.

Children who live in a city know how carefully birds, squirrels, and other animals are cared for in the city parks. Visitors to the parks bring crumbs, grain, or nuts. They like to watch the animals when they come close to get the food.



© Haynes, Inc.

These bears live in one of the great parks of the United States.

Here they are fed and protected from harm.

In the city streets pigeons and sparrows fly in and out among the trucks and wagons to pick up crumbs and grain. Have you ever watched a crowd of birds helping a horse to eat his lunch? As he shakes his feed bag, the grains drop to the ground. A dozen little bills are ready to snap up each grain that falls.

Do you know any other ways by which people help to feed wild animals?

Perhaps you feel sorry that so often there is little food for animals. When you feel that way, try to remember some of these things.

People do a great many fine things to help animals to have food.

Animals have good ways of finding food. They do better than most people could if they had to find every bit of their own food out of doors.

Most animals eat many kinds of food. If they cannot find one kind, they often can find another kind.

Making homes, caring for their young ones, and looking for food is about all that most animals have to do. Most of their work is looking for food. They can look for food all day long or all night long. Almost always they can find what food there is, when they spend so much of their time looking for it.

If all animals could find enough food to eat, there would be too many animals. Soon the earth would be covered with animals. There would be no room for anything else.

THINGS TO THINK ABOUT

Many things happen to take away the food which people are trying to save. They are almost the same as the things that take away the food of other animals.

Frost

Too much dry weather

Too much rain

Storms and floods

Harmful insects

Other harmful animals

Can you tell how these things harm the food of people?

You have read many of the things which animals do when there is little food. How are people able to have enough food when these things happen to their food?

THINGS TO DO

What animals can you help to keep from starving during the winter? What animals can you help to keep from starving during the summer?

What food shall you give them?

What plan have you for giving this food to them?

Animal Enemies

Have you ever watched a cat running away from one of his enemies? How does he protect himself? From what animals does a cat try to keep away?

What animals try to keep out of reach of a cat?

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Even these great ugly animals have enemies. They fight each other fiercely. Men hunt them for their skin. Insects sometimes crawl into their skin and do great harm

W. L. Underwood



Do they escape from him? How do they make their escape?

Many animals try hard not to be eaten. But they work just as hard to catch other animals for food for themselves. Can you tell about any animals which do this?

Can you name an animal that has no enemies?

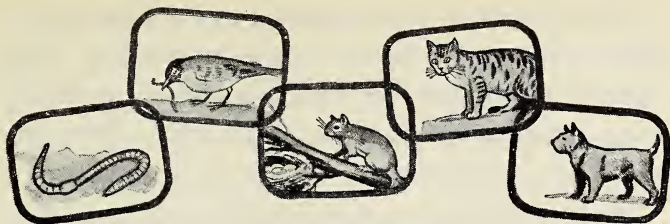
Do you think it would be a good thing if none of the animals in the world had enemies? Why not?

WHICH ANIMALS ARE ENEMIES?

All animals have enemies. Almost always their enemies are animals that want them for food.

It is not always true that an animal is smaller than its enemy. Many times smaller animals, such as insects, make life very unhappy for larger ones. Some spiders can throw out a poison which will kill a much larger animal. Cows, horses, dogs, and other animals are troubled by flies and mosquitoes. Surely people are troubled by insects in many ways. Can you tell some of the ways in which insects trouble people and other animals?

Did you ever stop to think which are the large animals and which are the small ones? It is hard to know, isn't it? Most animals are larger than some and smaller than others.



Read to find out about this food chain

We need not be surprised, then, to find out about food chains. *Food chain* is a queer name for the way some animals get their food. Here is a food chain.

In a pine wood little insects called aphids drink the juices from the trees. Spiders eat the aphids. The spiders are food for small birds. These small birds, in turn, may be caught and eaten by owls. We call this a food chain because it is a whole chain of animals which are looking for food.

Here is another chain of enemies: Insects and worms are eaten by birds. Red squirrels sometimes kill the birds and eat their eggs. Cats hunt the squirrels. Dogs are enemies of the cats.

The very small animals are not often in danger from the very large ones. A large animal like the lion does not feed on mice. It would take too much of his time to catch and eat enough mice for a good meal. A lion kills a large animal, such as a zebra, for food.

Many animals have enemies somewhere near their own size. The cougar, or mountain lion, kills a deer or a young calf for food. Rabbits and squirrels are not big enough to make him a meal. They are killed by smaller animals, such as the wildcats.

Many animals are eaten before they grow up. Great numbers of caterpillars never change into butterflies at all, because hungry birds come along in need of food. The eggs of fish and toads make fine food for other water animals. Thousands of them never grow into little fish or tadpoles at all.

Although people are a great help to animals, they also do them great harm. Hunters and fishermen have taken the lives of many animals. They have made some kinds of animals nearly extinct. They have done more to make some animals extinct than all of their other animal enemies put together.

A number of kinds of birds have been made almost extinct by hunters. The Indians and the early white people to come to America used to shoot wild turkeys for food. Wild turkeys are very much like the turkeys now raised by farmers. But they are bigger and more brightly colored. For many years hunters shot wild turkeys for pleasure. Now there are only a few wild turkeys in the country. These are found deep in mountain woods or in swampy places which are hard to reach.

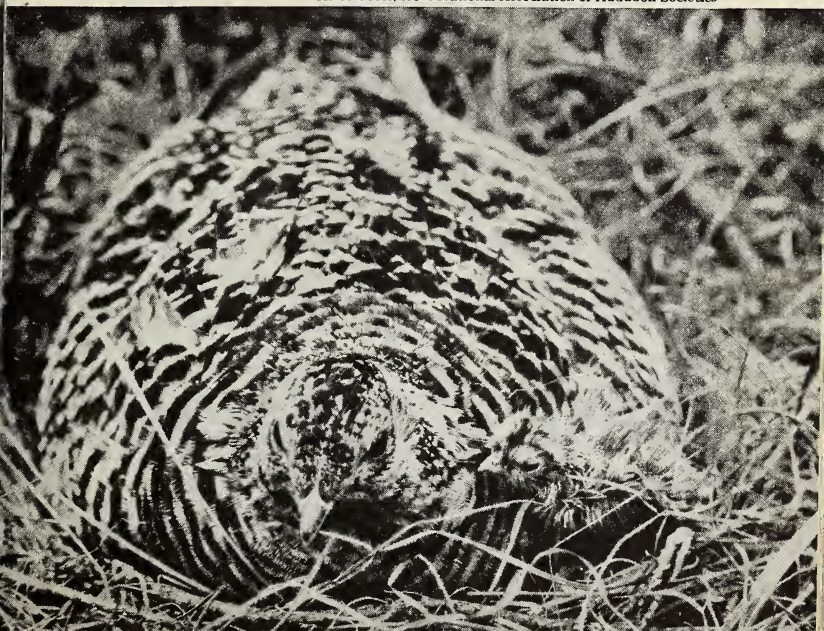
The same thing is true of prairie chickens. For many years these birds covered the prairies of the west. Although a great number of them can still be found, they have become extinct in many places.

The Indians and early white people in America shot deer for food and had many uses for the skins. Then for many years, men hunted deer for fun, until some kinds were nearly extinct.

Some people have been enemies to some helpful animals without knowing that these animals were helpful. Skunks, some kinds of hawks, crows, and owls have been used very badly.

A prairie hen with her baby chick

A. O. Gross, from National Association of Audubon Societies



Skunks have been known to eat chickens and eggs. Hawks have been caught taking chickens, ducks, or young geese. Crows make trouble for the farmer by eating his seeds and young plants. The great horned owl does many things that people do not like. He eats chickens, turkeys, song birds—even rabbits and skunks.

These are some of the bad ways of skunks, hawks, crows, and owls. For a long time people knew more about their bad ways than they did about their good ways.

They did not know how many grasshoppers, beetles, cutworms, mice, rats, and gophers are eaten every year by skunks. All these animals make trouble for the farmer by feeding on his crops.

People did not know how many barn mice, field mice, and ground squirrels are eaten by the hawks. They did not know how many beetles and other insects are eaten by crows.

They believed that all owls had the bad ways of the great horned owl. Owls eat hundreds of mice and rats every year. Even the great horned owl eats many mice, rats, squirrels, and other animals that are harmful to the farmers.

Now that people are learning that skunks and most owls and hawks do more good than harm, they will protect them instead of killing them.



Hawks and owls help farmers in many ways

When we think of how many things people have done to harm animals, we are very sorry. No one has meant to do so much harm. People have only been careless.

Many, many people have done none of these harmful things. Instead, they have done much to protect animals. They have done much to help other people to protect them, too.

Read to find out how skunks help farmers





When the toad sticks out his long tongue,
the insect is gone before you can think

HOW ANIMALS CATCH OTHER ANIMALS

Each kind of animal has its own way of catching the animal it wants for food. Some animals are able to catch others because they are bigger and stronger. That is true of a dog who wants a rabbit or a chicken for dinner.

Other animals catch their food by being quiet and watchful. Did you ever see a cat watch and wait a long time for a mouse or a bird? He comes closer and closer without a bit of sound. Then, with a noiseless jump, he holds his dinner fast in his claws. Tigers, wildcats, and cougars get their food in this way.

Turtles, toads, and frogs are quiet, watchful hunters, too. When they are hungry they sit very

still until an insect or other food comes near. Then snap goes the turtle's mouth, and the food is inside. So quickly that you can hardly see it, the toad or frog sticks out his tongue and pulls back an insect. When food comes close to these hungry animals, it is gone before you can think.

A number of animals are so strong and so quick that they are not afraid to catch animals much larger than they are. A lion can kill a giraffe, which is more than two times as large as he is.

The lion springs heavily upon the neck of the giraffe. He hangs on so tight that the giraffe cannot shake him off. The giraffe's neck is long and thin. Its head is very small and far away from its body. It cannot fight against the lion's thick neck and great head, with its strong jaws and long, sharp teeth.

A giraffe's hoofs are little help against the ugly claws of the lion. Sometimes he is able to kick with his hard hoofs. But almost always the large, quiet giraffe has to give up in the fight against the fierce, strong lion. The only way he can keep from being killed is by seeing the lion first. Then he can run away on his long, strong legs.

Some animals go together in bands to hunt. By working together, wolves kill deer and cattle, which are much larger than they are. They have killed

many cattle and sheep on the cattle lands of our country.

Each kind of animal has its own way of catching its food. Each way seems to be the best for the kind of animal that uses it.

The sharp claws and heavy feet of the lion would not help a turtle to catch the kind of food it needs. Lions do not need to hunt in bands as wolves do. They are strong enough to hunt alone. Each animal has a way of catching food that is best for that kind of animal.

HOW ANIMALS ARE PROTECTED AGAINST THEIR ENEMIES

Every animal has some way of protecting itself against its enemies. Some animals have a number of ways which help to save their lives.

Color Protects Some Animals

Many animals are protected by their color. Their coats have colors like the colors of the places in which they live. Because their color is so like the places around them, they are not easily seen by an enemy. Woodchucks are the color of dry grasses. Toads look like pieces of earth. Tree frogs become the color of the place where they are sitting. Winter birds are gray and white like the snow with its



Black Star

Do you see how this little deer might be
well protected by the white spots in his coat?

shadows. Baby deer are brown, with many large white spots. Their coats look like the ground where the sun is shining through the leaves. One might pass more than one baby deer and not see him.

The brown spots on the yellow coats of giraffes look like the shadows of leaves. Sometimes a whole crowd of giraffes pass by without being seen, because their color is so like the trees and grasses around them.

Bad Taste

Some animals are not eaten by enemies because they have an unpleasant taste. Toads have a bad-tasting liquid in their skin. When a dog or other animal bites him, this liquid flows out, and the toad is dropped right away.

Few animals try to use mink for food, because they have such a bad taste. Many butterflies have a taste that animals do not like. The beautiful monarch butterfly is one of these. Birds see their bright orange wings and leave them to fly about in safety.

Getting Out of Danger's Way

Many animals cannot fight. Their bodies are not built for fighting. But most of these animals can get out of the way quickly when danger is near.

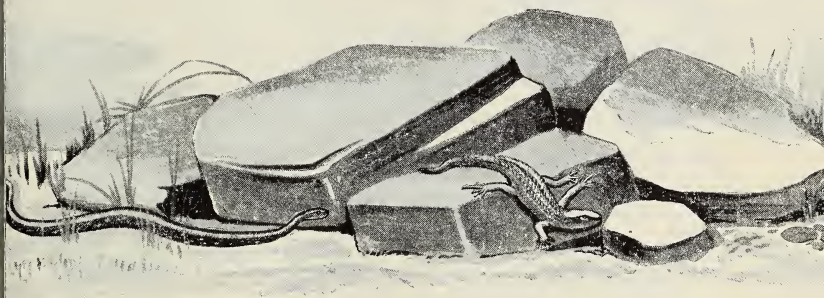
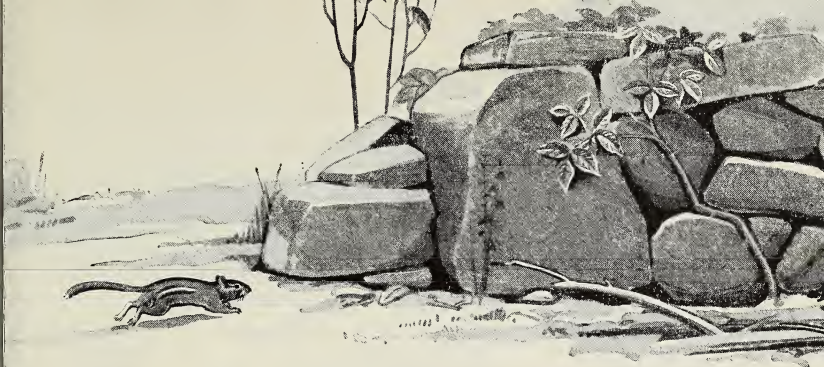
Chipmunks hurry into their holes or hide themselves quickly in leafy places.

Snakes and lizards wriggle out of sight so quickly that you can hardly see them go.

Rabbits hop quickly away. They can take long, high jumps into thick bushes where their enemy cannot follow.

Birds and insects fly away into the air.

Giraffe and deer can run on and on for miles without getting tired.



Muskrats are poor runners. Their bodies are heavy, and their legs are short. But muskrats save themselves by swimming away. Weasels and mink are quick runners, but they are strong swimmers too. They often get away from danger by swimming away through the water.

Fighting Back

Other animals meet their enemies by fighting back. Bees sting. Wolves, dogs, and foxes bite. Mice, muskrats, squirrels, and even rabbits often use their long front teeth on an enemy.

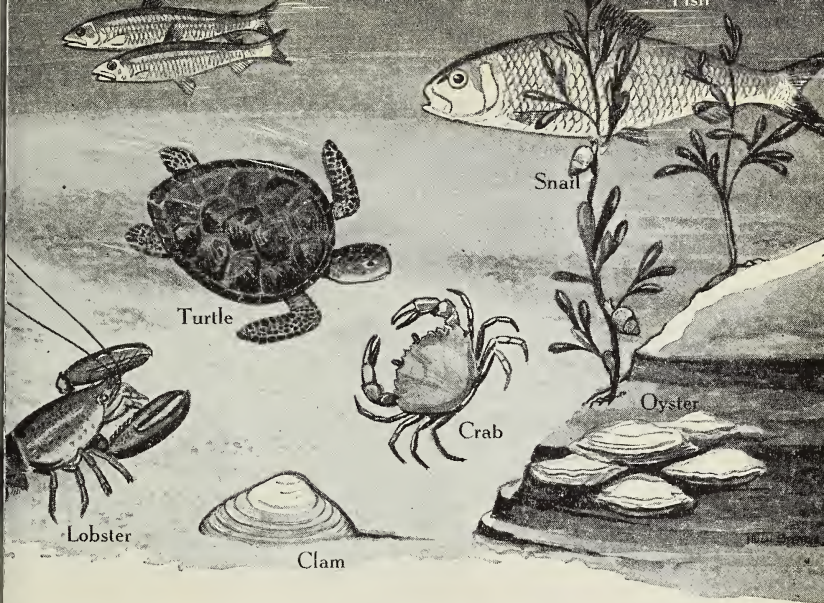
Lions and tigers claw. Cows, goats, and deer use their horns to protect themselves. Birds use their bills. Horses and giraffes kick. Sometimes horses bite.

Skunks throw out a liquid which has a very bad smell. Some snakes and spiders throw out a poison which kills their enemies when they bite them.

Body Coverings

Some animals are protected by the coverings of their bodies.

Turtles and snails can draw their bodies into their shells. Then they close part of the underside of the shell like a door. It is closed so tight that an enemy cannot get inside.



These animals have coverings which protect them from their enemies

Oysters and clams lie safely in their shells at the bottom of the water.

Crabs and lobsters are covered with strong shells. These shells do not grow as the animals get larger. The old shell falls off and a new one takes its place. Sometimes a small enemy crawls into the shell of one of these animals. When the shell falls off, the enemy also is left behind.

The thick skin of an elephant is a great help to him. The scales of fishes help to protect them from harm.

Thick fur protects many animals, for teeth and claws do not cut through it easily. Porcupines have quills that are sharp as needles, growing with the rest of their hair.

Nearly all animals have a covering strong enough to protect them.

Living in Safe Places

Some animals spend their lives in places where few enemies can reach them.

Many of these animals stay under the ground. Woodchucks stay in their holes much of the time. Gophers, moles, and earthworms spend most of their time underground. Their food is underground. They do not need to come above the ground, where other animals can see them and eat them.

Salamanders usually are safe under logs and stones.

Clams dig their way around in the mud at the bottom of lakes and in the sand on the seashore. Many crabs and worms also live in the sand.

Many other animals live in places that are too high and dangerous to be reached by their enemies. Mountain goats and sheep live in rocky places high up in the mountains. Most other animals cannot climb over these sharp, uneven rocks. Even if they could climb up there, they would find little food.



Black Star

These mountain goats are great climbers. Few enemies
can get near them in their shelter among the rocks

But there is enough for the mountain goats and sheep, and they are quite safe from harm.

Eagles make their nests high up among the rocks where most other animals would not find room to live. Stormy petrels are birds which build their nests in cracks in the rocks high above the sea.

Many animals come out only at night. In this way they are safe from the animals that move about and find their food in the daytime.

The sidewinder snake is found in desert lands. This snake cannot live in the sunlight. It hides away in dark places during the day and comes out only at night.

Large Families

Many kinds of animals keep on living on the earth because they have so many young ones. There are so many young ones that their enemies cannot eat all of them.

Frogs, toads, and fish lay hundreds and thousands and even millions of eggs. Although thousands of their eggs are eaten by their enemies, toads, fish, and frogs will probably always be with us. Cockroaches, mice, and rats will live on because they have such large families. Since they will eat almost any kind of food, few of them will ever die from hunger.

Now you know many of the ways by which animals are protected against their enemies.

But you must remember this. Although there are many ways by which animals are protected, many, many of them lose their lives. Only the quick, the strong, and the well-protected animals live on.

Do you think this is a good way for the world to be?

THINGS TO DO

1. All animals have some way by which they can protect themselves against their enemies.

Can you name other animals that are protected in any of the ways which the book tells about?

2. Make from clay an animal that is hunting another animal. If he is creeping up to surprise an animal, how must his body be made? If he is a strong fighter, what kind of jaws and teeth must he have? What kind of legs and feet? In what other ways can you show that an animal is a fighter?

3. Perhaps you would like to make a picture of some animals getting away from their enemies. See how many different ways you can show in your picture. Running, flying, swimming, and hiding are four of the ways that an animal can escape. Can you show these in your picture? Can you show any other ways of escaping from enemies?

WHAT PEOPLE ARE DOING TO PROTECT ANIMALS

At last people began to find out that some of their pleasures and many kinds of work were taking the lives of a great number of useful animals. Then they began to feel sorry and troubled. If there were no enemies of insects and mice, there soon would be too many of them. They knew that too many insects and mice would kill the trees and crops.



Lang

A safety ground for birds. No one may harm birds in this place.

Look to see the many kinds of feeding boxes. Can you find other ways in which birds may be protected here?

People found that they must save the lives of the birds and other animals that like insects and mice for food. Now they are trying in every way they can to save useful animals.

In city parks and country woods people have made bird safety grounds. In these places no one may harm the birds. In these safety grounds people do

everything they can to make life easy for the birds that come there. In the city parks bird houses, bird baths, and bird feeding places are set up. In the country woods the birds can find feeding places and watering places.

In different parts of the country fisheries have been built. In these fisheries thousands of fish eggs are carefully watched and protected. The young fish are carefully watched and protected, too. When the young fish are large enough, they can be sent to the streams and lakes. They are sent to take the place of the fish which have been caught by the fishermen.

People have been able to help the animals very much by making laws. Our country has made laws which say that people must not shoot too many useful animals. They can shoot these animals only during a short part of the year. The hunting season for most animals is in the fall. At that time most young animals are old enough to care for themselves. A hunter may kill only a small number of each kind of animal. Most kinds of fish also can be caught only for short times during the year.

Perhaps you can find out about the hunting season for these animals in the place where you live.

quail	wild ducks and geese	pheasants
partridge	deer	beaver

For some animals there is always "open season." That means that they can be hunted at any time of year. Some of these animals are

rabbits squirrels starlings sparrows

Can you tell why there is open season for these animals? Can you name other animals for which there is open season where you live?

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These men are working in a fishery. Do you see the fish eggs in the pan which the man is holding?

Galloway



THINGS TO THINK ABOUT

1. Do you think the lives of people are very much like the lives of other animals? Do we need the same kind of things to help us grow up that other animals do?

Tell some of the ways in which it is easier for people to get food than it is for other animals. Tell some of the ways in which it is easier for other animals to get food?

What can people do that other animals cannot do to be protected against the change of seasons? What can other animals do that people cannot do to be protected against change of seasons?

Long ago, people had to watch out for animal enemies all the time. The early people had to watch out for bear, wolves, and other large animals.

These animals do not trouble people now, but we still have animal enemies. Houseflies are a great danger. Other insects eat grain and other crops. Mice, gophers, and many, many other small animals are dangers to the food of people.

There are many other dangers in the everyday life of people. But we too are protected against danger. People are protected in one way in which other animals are not. People can think and plan.

Long ago, people learned that they could protect themselves against dangerous large animals by shooting them. Now people are finding ways to protect themselves against their small animal enemies. We protect ourselves against houseflies by keeping houses, streets, and farms clean. There are many ways to take care of harmful insects and other small animal enemies.

People have found ways to protect themselves against storms and cold weather. They have found ways of making clothes and building houses. They have found ways to keep warm in winter and cool in summer.

People have learned how to use things around them for their own good in many ways.

2. Here are some thoughts which are strange but true:

If all the children, grandchildren, and so on of one pair of rabbits should live for five years, the rabbit family would be as large as this:

1,200,000,000 rabbits

If all the children, grandchildren, and great-grandchildren, and so on of one pair of robins should live for fourteen years, they could eat up all the insects that are in Central Park in New York City. Even then some of them would be hungry.

If all the birds in the world should die, by the end of six years people would not be able to live on the earth. Can you tell why they could not?

What is your answer *now* to the question "Would it be a good thing if none of the animals in the world had enemies?"

3. Many, many millions of animals are born every year. Then why should not a fisherman or a hunter say, "I can take as many as I want, for there are plenty more"?

Why should not boys or girls take birds' nests out of trees before the baby birds can fly?

Why should they not shoot robins and other useful birds?

Why should they not catch chipmunks, squirrels, and other such animals which are easy to find?

THINGS TO DO

Suppose you should find a family of young squirrels which had lost their mother. Suppose there was no one to care for them but you.

Tell four things you would need to be most careful about if you were to keep them alive.

Do you think you could do these things so well that all would live to grow up?

V

How Animals Care for Their Young

ANIMAL FAMILIES

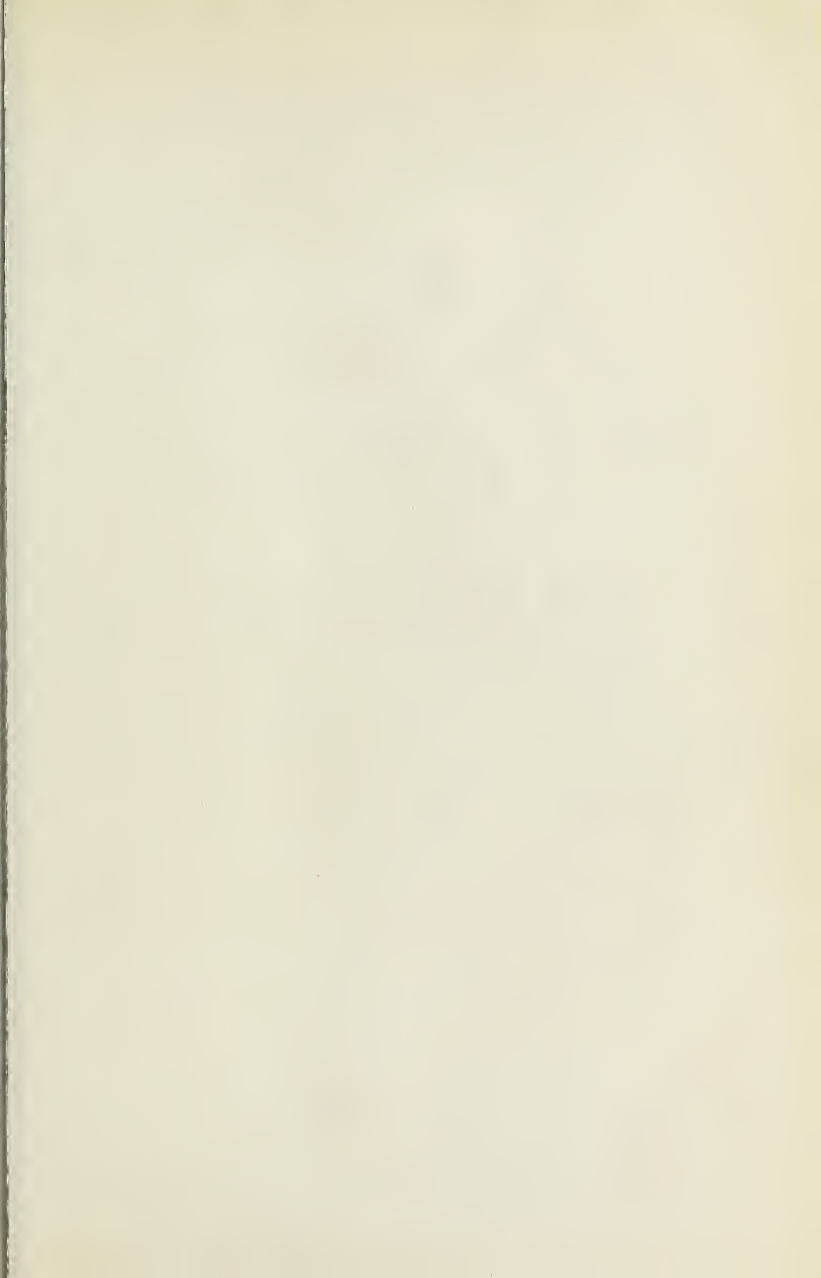
ANIMAL YOUNG THAT NEVER
SEE THEIR PARENTS

ANIMAL YOUNG THAT HAVE A LITTLE CARE

ANIMALS THAT GIVE THEIR YOUNG
MUCH CARE

FAMILIES CARED FOR BY THE FATHER ALONE

FAMILIES CARED FOR BY BOTH
FATHER AND MOTHER







JACOB
BATES
ABBOTT



WHAT are some of the things your mother did for you when you were a baby?

Suppose you had been able to care for yourself then as well as you can now. Would your mother have done so many things for you?

Suppose your mother had a thousand children, or even a hundred. Do you think she would have given you so much loving care?

Do your parents still take care of you in many ways? Do you suppose they will ever stop doing so?

THE COLORED PICTURE IS FROM A PAINTING BY JACOB ABBOTT.

Animal Families

There are all kinds of families in the animal world. There are large families and small families.

There are some families in which the young babies are carefully cared for by the parents. There are other families of young that would not know their parents if they should see them.

There are families in which both the father and the mother care for the young animals. In some families, only the mother cares for the young. These baby animals never see their father at all. In other families, only the father cares for the young. These baby animals never see their mother at all.

Some animals are cared for by their parents for a long time. Others are just started in life and then are left to care for themselves.

Some animals are very helpless when they are born. Many baby birds can do nothing but call for food. Young opossums cannot even do that.

The young of other animals are able to take care of themselves as soon as they are born. Most insects, fish, alligators, and many other animals do not need a mother's care. They can take care of themselves as soon as they are born.

Some baby animals are very tiny. The young of many insects are no larger than the point of a pin.

Some baby animals are very large. A baby elephant weighs as much as a very large man.

The young of some animals look like their parents. You always would know that a puppy is a baby dog. It looks very much like the mother or father dog.

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This baby will need great care for many years.

Human babies need more care than any other babies in the world

Lambert



The young of some other animals do not look at all like their parents. When young caterpillars come out of the egg, they look very little like the mother butterfly that laid the egg.

All kinds of families are needed to make up a world.

Animal Young That Never See Their Parents

CODFISH

Many animal mothers have over a thousand animal children. Can you wonder that they do not stay near them to feed them and to keep them out of danger? They could not do so if they tried.

The young of these animals travel around very fast as soon as they are born. No parents in the world could keep watch over them all, even if they should try to do so. The young are well able to take care of themselves as soon as they are born.

Codfish belong to these large families. The mother cod lays over six million eggs. Each egg sails around by itself on the top of the water. How could any mother keep watch over a family like this?

Of course a great many of these eggs and a great many of the young fish are eaten by bigger fish. But this is a good thing. If fish came out of all the eggs and lived to grow up, the sea would be filled with codfish. There would not be enough room for other kinds of fish.

SALMON

Salmon are fish which also lay thousands of eggs.

The parent fish live in salt water. They need to lay their eggs in fresh water. They swim hundreds of miles up the streams and rivers to do this.

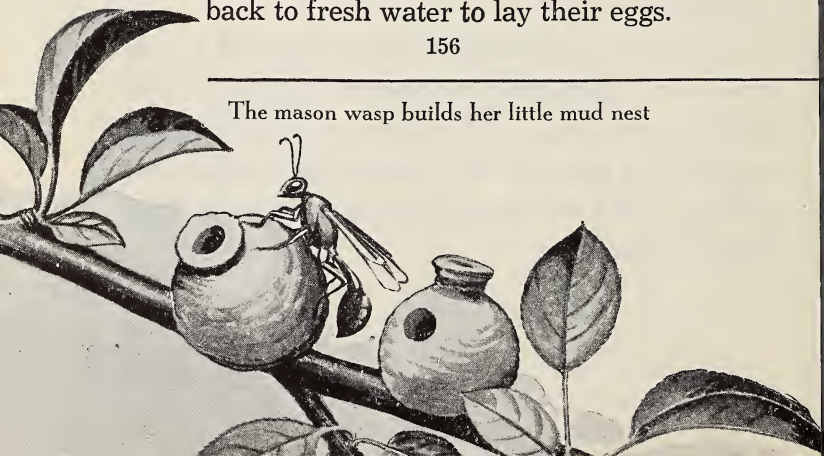
Sometimes they swim between rocks where the water runs very fast. Sometimes they jump over high waterfalls. Most salmon lay their eggs where the water is very cold.

After the eggs have been laid, the fish swim away and leave them. With some kinds of salmon, the parent fish die soon after the eggs are laid.

The eggs do not stay on top of the water as the eggs of the cod do. They drop to the bottom and are covered with mud and sand.

In some places the young fish start to swim back to salt water while they are still very small. After a few years in the salt water, they find their way back to fresh water to lay their eggs.

The mason wasp builds her little mud nest



GRASSHOPPERS

Grasshoppers too have very large families they never see. The mother grasshopper gets ready for her young very carefully, however. She lays the eggs where the young will find plenty of food. She leaves the eggs in a safe place.

Early in the fall, she digs a hole in the ground. In this hole she places a number of cases of eggs. Each of these egg cases holds from twenty-five to one hundred and twenty-five eggs.

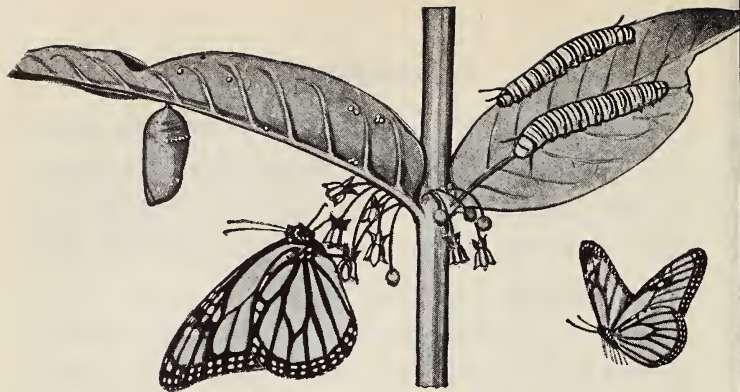
When cold weather comes, most of the grown-up grasshoppers die. The eggs stay carefully stored away in the ground all winter. During the next spring, young grasshoppers come out of the eggs.

The young grasshoppers have very large heads and no wings. But they look very much like grown-up grasshoppers and work like grown-up grasshoppers.

As soon as they come out of the ground, they begin to eat the leaves of grass. Young grasshoppers find plenty of food. They do not seem to need any more help from their parents.

MASON WASPS

The mason wasp builds a mud nest on the stem or leaf of a plant. When the little round nest is finished, she fills it with the bodies of spiders. The young wasps use these spiders for food.



Here is the life story of the monarch butterfly

She lays an egg in the little pile of spiders. Then she places a smooth little mud door over the top.

She keeps on working until she has made several of these nests. The little wasps which come out of the eggs have a fine store of food. This food lasts until they are big enough to leave their mud homes.

THE MONARCH BUTTERFLY

Another animal that leaves good food for her large family is the beautiful monarch butterfly. She lays her eggs on young, leafy milkweed plants. When the young caterpillars come out of the eggs, they feed upon the milkweed plant. They can feed here until they are full-grown.

Then they fasten themselves to the undersides of the leaves. They go into a resting time. Now their

covering is a lovely green. It looks as if it were held together with gold nails.

At this time a great change takes place. In a few days the caterpillars have changed to red-brown butterflies like their parents.

But their mother probably never sees them. She is far, far away. If she did see them, she would not know them.

She could not take care of her large family if she should stay near them. When they are young, they are quite different from her. Even their food is not the same. And there are too many of them for any mother to care for.

This mother does not need to stay near her young. They are able to take care of themselves as soon as they come out of the eggs.

COWBIRDS

Mother cowbirds do not take care of their young themselves. But they see to it that they have good care. They see to it that the young are cared for by other mothers.

This strong brown bird does not build a nest of her own. She lays her eggs in the nests of other birds who are smaller than she is. She often chooses a warbler's nest. The mother warbler takes care of



The baby cowbird is almost as big as the mother warbler.

Read to find out how a baby cowbird happens to be in a warbler's nest

the big baby cowbird along with her own smaller babies.

Sometimes the baby cowbird comes out of the egg first. Then the mother warbler has to leave her own eggs to feed the cowbird. This means that the little warblers do not come out of their eggs at all.

Sometimes all the birds come out of the eggs at the same time. The baby cowbird is much, much stronger than the rest and it gets most of the food. The baby warblers are often pushed out of the nest by the big hungry cowbird. The poor mother warbler is quite worn out by caring for this hungry bird, who soon is larger than she is.

Cowbirds make trouble for people as well as for other birds. They do eat harmful insects. But they also take the lives of many helpful birds, and so do more harm than good.

It would be better for all if this mother would care for her own young. The young are not able to care for themselves as many young are. They need a mother's care.

ALLIGATORS

Alligators too lay their eggs in a good place. Then they go away, leaving the young to care for themselves.

The mother alligator makes a very queer nest. She gathers together a big pile of dry leaves, twigs, and fine earth. She crawls into the ground under this pile. Then she lays about thirty or forty eggs. With this, her care for her young is ended.

The hot sun and the moist ground soften the sticks and leaves. The place becomes very warm while this is happening.

After many weeks the young alligators come out of the eggs. They crawl out of their eggs and out of the ground. They find the water right away. They do not need their mother's care. After they have moved into their new home they live about as the big alligators do.

THINGS TO THINK ABOUT

1. Suppose that parents of the very large families of animals should try to take care of all of their young. Do you think the young would have any better care than that which they give themselves? There are too many for the mother to feed. She could not make a home that would hold all of them.

They can find food for themselves. They can get away from their enemies. They can find shelter. Most of them take as good care of themselves as the grown-up animals do.

2. Do you wonder that such large families happen to be born into the world? These kinds of animals are able to stay on the earth only because there are so many of them. Thousands and millions of them are used for food by other animals. If the families were not so large, these animals would soon be extinct.

THINGS TO DO

1. What other animals do you know about that do not have care from their parents after they are born?

Tell some of the things you know about these animals.

2. See if you can keep an animal from one of these large families in your schoolroom. A caterpillar is a good animal to choose.

Be sure to find the right kind of food for it. Find out how it lives through the winter.

Can you give this animal better care than it can give itself?

Animal Young That Have a Little Care

Some baby animals are very strong as soon as they are born. They are covered with fur or feathers. They can run about. Their eyes are open. They can see their food and watch for enemies. But these young animals need their mother's care for a short time.

JACK RABBITS

The home of jack rabbits is an open nest under bushes or weeds. The mother jack rabbit pushes down the grass with her feet. This makes a soft place for the nest. She makes the nest soft inside with fur that she pulls from her body. This does not hurt the mother rabbit because the fur comes out very easily.

Young jack rabbits need little care from their mother. They are covered with fur when they are born. Their eyes are open. They can run about.

In a short time they are very quick and strong. They stay with their mother as long as they need her milk for food. As soon as they can eat other food, young jack rabbits leave the nest and take care of themselves.

MALLARD DUCKS

Mallard ducks are the best known of all the wild ducks. These young ducklings need their mother's care for only a short time.

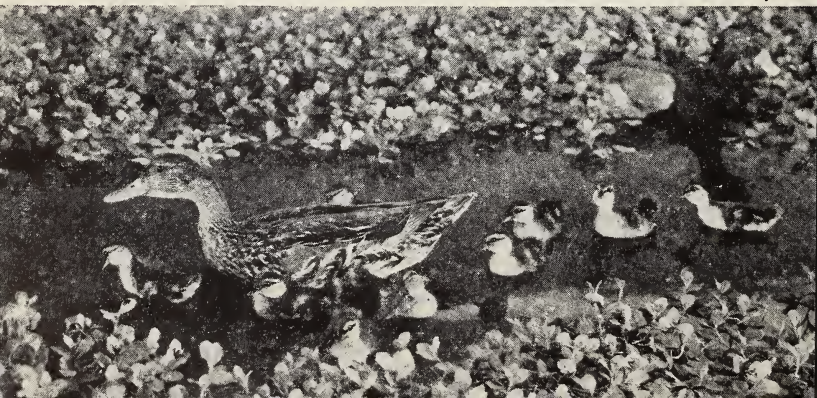
In the nest the mother duck places thick, soft down from her own breast. She lays about fifteen eggs.

The ducklings that come out of these eggs are wide-awake little balls of down. They run about, picking and digging for food soon after they come out of the shell.

The little Mallard ducklings do not stay in their soft, downy nest very long. In a short time they can get along without their mother's care. They soon travel away by themselves to find new feeding places.

How well these little Mallard ducklings seem to take care of themselves!

American Museum of Natural History



OTHER ANIMALS

Many other animals need care for only a short time. Young chickens and turkeys, young geese and ducklings are quite strong. They are able to run about almost as soon as they come out of the eggs. After a few weeks they leave their mothers and hunt for food by themselves.

THINGS TO THINK ABOUT

These animals and many others soon learn to take care of themselves. Can you name other animals which need their mothers' care for only a short time?

Can you think of any reason why these animals should stay with their mothers for a longer time?

Animals That Give Their Young Much Care

Many mammals have small families of babies that need much care. Because these families are quite small, the mother is able to give them the care which such helpless babies need.

ELEPHANTS

The mother elephant has only one baby at a time. Once in a while there are elephant twins, just as there are boy or girl twins.

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The grown-up elephants show the young ones how to take care of themselves. What do you think is going to happen here



An elephant baby has very good care. The mother pushes down the grasses with her feet. This makes a soft bed for her two-hundred-pound baby. He cannot walk around on his weak legs right away, as a calf or a colt does. He is several days old before he can move about very much.

When he is old enough, the baby elephant runs along through the forest close to his mother. At first he feeds on his mother's milk. Then he eats leaves and grasses, but he never has any meat.

Several mother elephants with their babies travel together. They are called a herd of elephants. In a herd there may be babies, mothers, grandmothers, and great-grandmothers all traveling together.

The young elephants walk along under their mothers' bodies. The mothers try to stay in the middle of the herd. This helps to keep the young elephants away from danger.

During her lifetime a mother elephant has several babies. She gives the same good care to each one.

WHALES

Some of the whales are said to be the largest animals that have ever lived on the earth. There are whales that weigh more than seven thousand men. Many towns do not have nearly so many men as that.

These big whale mothers have big whale babies. Whale babies are about fourteen feet long. Measure fourteen feet in your schoolroom to see how long a baby whale may be.

For many weeks this giant baby cannot care for itself nearly so well as a baby jack rabbit can. It feeds on its mother's milk for many more weeks than the jack rabbit does. For many weeks the mother watches and cares for her baby. Then she teaches it how to care for itself.

BLACK BEARS

The mother bear is another large mammal that has few children in her family. She almost always has two babies at a time. Unlike the young elephants and the whales, the bear babies are very small when they are born. They are only eight or nine inches long. Measure on your ruler to see how small that baby is.

They are very helpless. They have no hair on their bodies. More than a month passes before their eyes are open and they are able to follow their mother about.

Bears hibernate in winter. In the coldest lands they stay in their shelters during most of the winter months. Like other animals, they hibernate for a

shorter time when the winters are short. Sometimes their shelter becomes uncomfortable and they leave it to find another.

The mother bear stays in her shelter for some time before the babies are born. She stays there for a month or two after they are born.

She has to eat enough in the fall to last during the time she stays in her shelter. She must eat enough to feed her babies when they are born in January or February. What a good thing it is that they are so small!

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These young bears are growing big and strong.

But their mother watches over them very carefully

Galloway



A hungry family steps out of the cave when spring comes. In the spring there is much food that bears can eat. The young bears soon grow to be big and strong.

They are very playful and seem to need to learn a great deal about growing up. Sometimes when they get into too much trouble their mother sends them up into a tree. She sometimes sends them up there to get away from danger. She makes them stay there until she is ready for them to come down.

Young black bears stay with their mother until fall. Then they find shelter for themselves. There is a kind of bear which stays with the mother for nearly two years. When they leave the mother they are well able to care for themselves.

RED SQUIRRELS

Some animal mothers have quite large families of babies that cannot take care of themselves at first. Their eyes are closed. They have no covering on their bodies. However, they grow fast enough to care for themselves in a short time.

The homes of the red squirrels are likely to be found in holes in trees. The father and mother squirrels make the nest soft and warm with dry grass

and leaves. In May or June four, five, or six baby squirrels are born. There is only one family a year.

These baby squirrels are not at all pretty. Their eyes are closed, they have no fur, and their heads are very large. After a while their eyes open. Their bodies become covered with red-brown fur. As they grow older, their heads do not look too large for their bodies. They are much prettier then.

The red squirrel is a careful mother. The young squirrels do not leave their homes until they are almost full-grown.

ORIOLES

Orioles have large families of very helpless young. But somehow or other the parent birds are able to take care of their large families.

Oriole parents make a beautiful nest of grasses, bits of string, and hair. The father gathers these together. The mother makes them into a long pocket, or bag. This hangs from the twigs on the very end of a high branch.

The bag-like nest is wide at the bottom. When the birds are inside, the nest pulls down so that it is longer and thinner than it was before. A cat or other animal cannot reach into it easily. The whole family of orioles is safe from almost any enemy when they are in this pretty shelter.



The father and mother oriole build a fine safe nest for their young

The mother bird sits on the eggs while the father watches the nest. Soon from four to six little orioles are crying for food. Their eyes are closed. They have no feathers. They are covered only with skin.

The father works very hard indeed to bring enough worms and insects to feed his large family. They cry so much for food that they are called the "cry babies" of the bird world.

At last their eyes are open and they are covered with coats of feathers. But the father keeps on bringing them food. Young orioles are cared for until they are able to fly.

OPOSSUMS

Some animal babies are even more helpless than those about which you have just read. Some of these are carried about in a pocket in the under part of the mother's body.

Baby opossums are so small and helpless that they are carried about in this way. The mother opossum is about as large as a mother cat. The opossum babies are about one-half inch long. Look on your ruler to see how very small these babies are. In the under part of her body the mother has a pocket in which she keeps these tiny babies.

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The opossum is a busy mother. Read to find out
how she takes care of two families at the same time



In three or four weeks the babies are as large as house mice. But they do not leave their mother's pocket until they are two months old.

The mother makes a home in a hole in a tree or in grasses near a swamp. This nest shelters the mother and her babies until the young are able to care for themselves.

The mother has two or three families a year. There are from five to fourteen babies in each family. After a while the babies of the first family are about as large as house rats. Then the babies of the second family begin to live in the mother's pocket.

Now the first family must eat something besides their mother's milk. So they all go out to look for insects, grain, fruit, or vegetables.

Perhaps you wonder how the mother carries so many children around with her. While the second family is being carried about in her pocket, the first family rides on the mother's back. The mother holds her tail over her back. Then the little ones fasten their tails around it. They also stay on by holding to her fur.

Is not the opossum a busy mother?

MONKEYS

Many monkey mothers carry their babies in their arms very much as human mothers do. Human mothers are mothers of people. It is not safe to put human babies down and leave them. It is not safe for the mother monkey to put her baby down and leave it. Human babies would get into many kinds of trouble if they were left by themselves. Young monkeys might get into many of the same troubles.

Tell what you think might happen to the monkey's baby if it were left alone.

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A mother monkey gives her baby great care for a long time



CATS

Other animals carry their babies about when they are still young and cannot help themselves. These animals do not have a pocket in which to hold their young. But they find a number of other ways for carrying them about.

Have you ever seen a mother cat move her kittens when she wants them in another place? How does she carry them? Why does she move them? Can she leave them by themselves when she goes to hunt for food?

THINGS TO THINK ABOUT

You may have seen pictures of kangaroos in your picture books. Do you remember the bright-eyed baby looking out of its mother's pocket? This baby is carried in the mother's pocket for several months. It needs its mother's care for a very long time.

Have you ever watched a mother dog caring for her puppies?

What other animal mothers do you know about which give their babies care for a long, long time?

Families Cared for by the Father Alone

THE STICKLEBACK

There are a few families in the animal world where only the father takes care of the young.

The stickleback is a small fish about two or three inches long. It is found in streams and oceans in many parts of the world. In the spring the father's body takes on bright colors. During that time he looks like a small rainbow. He is called a stickleback because a row of sharp points sticks out of his back. Because of these points, any fish which tries to catch a stickleback is very sorry afterwards.

The father stickleback makes a nest for the eggs. He pulls together bits of stems, leaves, or seaweed.

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The father stickleback makes a fine nest for the eggs.

Read to find out how he takes care of the eggs and the young fish



With a sticky liquid from his body he fastens them together into a tiny round nest. This strange nest has a front door and a back door. It has a room in the middle for eggs.

When the nest is ready he drives a mother fish inside to lay her eggs. She swims through the front door. She lays her eggs in the little room. Then she leaves the nest by swimming out of the back door. The father stickleback drives many more mother fish inside to lay their eggs in the nest he has made.

When the nest is full of eggs, the father keeps watch at the door. He protects the eggs from all enemies. The mother sticklebacks would come back to eat the eggs if the father did not keep them away.

Even then, this father's work is not over. He seems to spend his day trying to keep the young fish near the nest. As soon as he drives them all in at one door, they swim out of the other. They will not stay in the nest, as their father seems to want them to do. But it is likely that they are saved from much harm by staying so near the nest.

SEA HORSES

A sea horse also is a careful father. He carries the eggs in a pocket in the front of his body. He carries them around until the young fish are ready to come out of the eggs.

THINGS TO THINK ABOUT

Perhaps it seems strange to you to have families cared for by the father. Many families are cared for only by the mother. We do not think this is strange because there are so many of these families in the world.

But families cared for by the father alone receive as good care as any other family. They receive the kind of care that is best for them.

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The sea horse is a careful father

New York Aquarium



Families Cared for by Both Father and Mother

In most families the mother does the work of caring for the young. Some families are cared for by the father alone. Many times, however, the father and mother work together in caring for their young.

We have read how both parents of the oriole and of the red squirrel work together. The father goldfinch feeds the mother while she is sitting on her eggs. Among the grosbeaks and the wrens the father works as hard as the mother does in feeding the young birds.

Among some kinds of birds the father works very hard to bring food to the mother and the babies. Often he is tired out by the time the little birds can fly. His body becomes thin, and his feathers look worn. But the mother and the babies are fat and well, because he has taken such good care of them.

SCARLET TANAGERS

Scarlet tanagers work together to take care of their young. The father bird flies all about looking for food. The mother bird stays closer to the nest. The father tanager has a bright red coat. He wears this coat as long as the baby birds are in the nest.

When he is flying about looking for food, his bright color is often seen by an enemy. Very likely this enemy would like to eat the baby birds. Instead of flying toward the nest, the father tanager flies away from it. The enemy follows him until it gets tired. Some scientists say that the bright colors of the father bird protect the baby birds.

Later on, the whole family fly about together looking for food. Then it might not be safe for the father bird to wear such bright colors. Enemies could be drawn toward the baby birds instead of away from them.

A very great change takes place in the color of the father bird at this time. The bright-colored feathers drop out of his coat, and yellow-brown feathers take their place. The father, the mother, and the baby birds are all about the same color at the time they are flying around together.

GRAY WOLVES

Young wolves have care from both parents. They choose a safe place for the babies to be born. Sometimes this place is under an old tree. Sometimes the wolves dig a hole in the ground. Sometimes they find a hole deep among the rocks. Sometimes two or three families use the same shelter.



Father and mother wolves take good care of their young

Usually six or seven young are born during the spring. At first their eyes are closed, and they are very helpless.

When they are older the young wolves are very playful. They roll and tumble about like puppies. However, the older ones snap and bite at them when they get in their way or waken them from a nap.

The gray wolf makes a good mother. At first the young wolves feed on their mother's milk. Later on she looks about for insects and other small animals. She has been seen turning over stones to find crickets for the family. Many times the father and mother look for food together.



W. Lyman Underwood

All day long these parent robins are kept busy bringing food to their hungry family

At last the young wolves are old enough to leave their shelter. It is said that the father, mother, and young wolves all travel along together hunting for food. In this way the young learn how to hunt by themselves.

ROBINS

Have you ever watched a pair of robins build their nest and take care of their babies? Here is a picture of a family of robins. Do you think their nest is very pretty? What do you think they used to make their nest? Who do you think takes care of the babies? Do you think it is very easy to keep these hungry babies fed?

OTHER ANIMALS

Both father and mother lion spend a long time taking care of the young lions.

Pigeons too receive care from both parents. The father bird almost always sits on the eggs in the day-time. The mother bird sits on them at night. The parents take turns feeding the young.

Animals cared for by both parents receive good care indeed. They should be able to live very well when they go out into the world for themselves.

THINGS TO THINK ABOUT

1. Human babies are babies such as you were when you were little. Human babies need most care of any babies in the world. They are unable to help themselves for the longest time of all. Human babies, of course, are cared for by both parents.

Human parents care for their children for years and years. They get food for their children. They give them a home. They see that the children have plenty of good, comfortable clothing until they are really grown up.

They send their children to school. Many parents send their grown-up children away to school. There they find out about the work they want to do during their grown-up lives.

2. It is true that many animals give their young great care. Perhaps you think that the lives of these animals are safer than the lives of the animals whose parents give them no care at all.

We cannot say which way is better. But we do know this. Some animals must receive great care for two reasons.

They are so helpless that they would not go on living at all without this great care. And they must be kept alive if that kind of animal is to stay on the earth.

There are so many grasshoppers that millions of them can die and grasshoppers will still be found on the earth. But if too many elephants should be killed each year, soon all the elephants would be gone from the earth.

Each way of caring for families is best for the animal that uses it. Great care is best for animals which need it. But little care is just as good for young animals which can take care of themselves.

VI

What Keeps Plants Living on the Earth?

HOW LONG DO PLANTS LIVE?

**PLANTS DO NOT GROW DURING
WINTER'S COLD**

ABOUT SEEDS





DO YOU KNOW?

Do you know that some kinds of plants live to be only one year old? They never grow any older.

Do you know that some plants are the oldest of living things?

Do you know why plants do not grow in the winter time?

Do you know why plants have seeds?

Do you know that seeds can travel for miles and miles?

Do you know the three things which plants need to make them grow?

THE COLORED PICTURE IS FROM A PAINTING BY COURTNEY ALLEN.

How Long Do Plants Live?

Soon after school begins in September, the cool autumn days come along in many parts of the earth. During these days, the out of doors changes. It begins to look like a different world.

The leaves fall from the trees. The grass and weeds grow brown and dry in the fields. Most of the flowers are gone from the gardens. The bushes are brown because they too have lost their leaves.

Many children ask, "Where have the flowers gone? Are the trees dead? Why does the grass stay brown and dry?"

Can you answer these questions?

Here are two answers to these questions: Some of the plants really and truly die when winter comes. They never will grow again. Other plants look as if they were dead in winter, but they really are not dead at all. They are resting through the winter months. When the winter is over, they will grow to look just as they did the summer before.

These two kinds of plants have names. They are called annuals and perennials. The plants which really and truly die at the beginning of winter are called annuals, because they have lived only one year. Plants which live on and on, year after year, are called perennials.



Do you like to watch the leaves fall from the trees?

What other changes do you see out of doors in autumn?

MORE ABOUT ANNUALS

On pages 188 and 189 are the pictures of some flowers which are found on annuals. Here are the names of some other flowering plants which are annuals:

petunia

marigold

zinnia

Do you know these flowers when you see them? Can you name some other flowering plants which are annuals? If you wish to have these flowers in your garden, you must plant their seeds every year. They will not live on through the winter.

Here are the names of some vegetables which are annuals.

peas

cabbage

radishes

beans

lettuce

tomatoes

If you raise these vegetables in your garden, you must plant their seeds every year. Can you name other vegetables which are annuals?

188

Sweet peas



Aster

McFarland



The Story of an Annual

Jean had a garden of sweet peas. Many different things happened to the growing plants. Jean's mother said it made her think of Jean herself growing up.

Early in April, Jean planted her seeds. She placed the seeds in a long row in the ground. She placed them far enough apart so that they could grow without crowding.

About three weeks later, tiny green plants pushed their heads above the ground. For a while Jean was very busy. She tried to protect the baby plants from the insects and birds that wanted to eat them.

Nasturtium



Poppies

McFarland





One warm April day, Jean planted her
sweet-pea seeds

When the plants were about six inches high, Jean's father said, "Your plants must have something to climb on."

Jean and father drove sticks into the ground. They built a kind of fence over the long row of sweet peas. They fastened

strings from the sticks to the fence.

Curly things like green threads grew from the plants. These are called tendrils. The tendrils soon fastened themselves around the strings, and the plants began to climb up and up.

Late in June, Jean began to watch the buds which were growing here and there on her plants. In about a week Jean picked a few flowers—pink, blue, and white. She gave her first flowers to her mother.

Jean's grandfather said, "The more you pick your flowers, the more flowers you will have to pick."

Jean thought this was very queer. But she picked her flowers very carefully every other day. Each time she picked them she had more to pick—just as her grandfather had said.

By the first of August, the plants had climbed higher than Jean's head. Someone else had to pick the flowers which grew at the top.

Jean said to her mother, "The sweet peas have lived only part of a year. But they have grown to be taller than I have grown in the eight years of my whole life."

Her mother answered, "You must remember that their life is much shorter than yours. In a month or so your sweet peas will be in their old age."

The sweet peas took much of Jean's time. They made a lot of work. Sometimes the weather was very dry. During this time Jean gave her flowers big drinks of water with her watering can.

Sometimes the weather was very stormy. Once the rain came down so hard that the plants were pulled and broken. After the storm Jean and her father worked hard to fasten the plants back on the fence. Then they could grow in the right way again.

In the autumn the flowers were not so fine as they had been during the summer. Little seed pods were forming here and there.

At last Jean said, "I think I shall not try so hard to keep

In August, Jean picked large bouquets of sweet peas





In September seeds were growing in the dry seed pods

the blossoms picked. I shall leave some on the plants, so that I can have seeds for next summer's garden."

By the time the frosts came, the sweet-pea plants looked dry, brown, and old. They had lived their life. They

had grown from the seed, they had flowered, and they had formed seeds of their own all in one year. But Jean could always have sweet peas in her garden. The plants left seeds which would grow into new plants the next year.

Can you tell why Jean's mother said to her, "Your sweet-pea plants make me think of you growing up"?

THINGS TO DO

Late in the summer, choose a plant which you would like to keep through the winter. Be sure to choose an annual.

Put this plant into a jar with plenty of earth from the place where it has been growing.

Give the plant the best care you can. See that it has

plenty of water. Keep it in a place where there is plenty of light.

Write down the month and day when you brought the plant into the house. See how long your plant will live.

You must not be sorry if your plant dies. Remember that it is an annual. An annual is not supposed to live more than a year, even if it has good care.

MORE ABOUT PERENNIALS

Perennials are very much like annuals in most ways. However, they do not die when autumn comes. They keep right on living, year after year, as people do. Some perennials live only a few years. Others live much longer than people ever have been known to live.

A large elm tree grew in front of Alice's house.

"That tree is very old," said her father. "When my grandfather was a boy he climbed up in it to see the first steam train go through this part of the country. It is over a hundred years old."

"Will it be standing when I am grown up?" asked Alice.

"Probably," replied her father. "We shall take good care of it."

In California some trees are growing which are more than four thousand years old. As long ago as Bible times the branches of these trees waved in the



Southern Pacific Railway

These giants are among the world's largest and oldest trees.

Read to find out when they began to grow

sunlight and gave nesting places to birds. They are the oldest living things.

All trees are perennials. How many kinds of trees

can you name? Every tree that you can name is a perennial.

Many flowers are perennials. On pages 195 and 196 are the pictures of some flowers which are perennials. Do you know these flowers when you see them in a garden?

Here are the names of some other perennials.

dandelion buttercup peony daisy

Can you name some other flowers which are perennials?

If the frost does not kill them, perennials will come up every year without being planted.

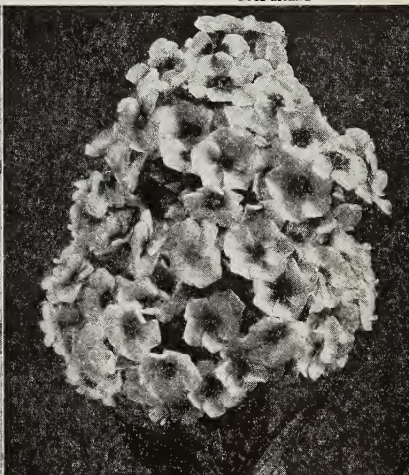
Very few vegetables are perennials. Almost all vegetables must be planted each year. Asparagus is a vegetable which comes up year after year.

Golden glow



Phlox

McFarland



Many kinds of weeds and many of the wild flowers are perennials.

Perennials in Winter

One cold day in autumn, Jean's mother said, "I must begin to take the plants into the house for the winter."

When Jean came home from school her mother was very busy. She was digging up some of the plants. She was putting them into pots filled with earth.

Mrs. Davis took these plants into the house. Many plants were left growing in the garden.

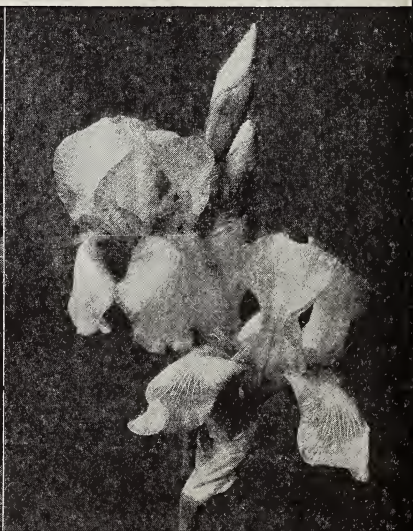
"How do you know which plants to take inside?" Jean asked.

Roses



Iris

McFarland





Beautiful plants will be growing in Mrs. Davis's windows during the winter

"I am taking in plants which are easily killed by the frost," Mrs. Davis answered. "Some plants are not harmed by winter's cold, so I shall leave them in the ground. Of course I shall leave all the annuals. They would not go on living even if they were taken away from the cold."

The next day many kinds of plants were growing in their pots in Mrs. Davis's windows. Geraniums,

begonias, coleuses, and other plants were standing where they could have sunshine all winter.

Most perennials are not killed by the frost in the ground. Many of them look as if they were dead in winter, although the frost has not killed them.

A woodchuck looks dead, too, when he hibernates all winter. But he is not dead. He is only resting. A few warm spring days will make him as full of life as ever.

We might say that perennials rest through the winter, too. Most of them lose their leaves. They do not grow. They look as if they were dead. But, like the woodchuck, they are only resting during the cold winter months. The warm spring days will change their looks very greatly. They soon will look green and alive again.

THINGS TO THINK ABOUT

Both annuals and perennials are needed to keep plant life on the earth. In some ways perennials have better ways to keep on living than annuals do. They have seeds as annuals do. These make new plants grow each year.

In perennials, food is stored away in the roots or stems. A tree whose roots grow deep in the ground is a very strong plant. It can live a long time without rain. It can live through the freezing cold of winter. It can live through the burning heat of summer.

Annuals cannot do this. They cannot live through freezing cold. They can live through great heat only if they have enough moisture. Their roots are short. They do not reach deep down into the earth as the roots of most perennials do. They can find little moisture for themselves. They must have rain or the water which people give them.

But annuals keep on living on the earth quite as well as perennials do. They are protected by their seeds. The plant dies at the end of its year, but it always leaves seeds. The seeds live on and on. As soon as they are given light and moisture, they will become plants of the same kind. Do you see how this helps plants to grow in a place where there is little rain?

Some people believe that seeds are the best protection a plant can have. Do you see why?

THINGS TO DO

Try this to show that the roots of some plants keep them alive while they are resting:

When winter is almost here find a place where the grass looks brown and dry. Be sure that it is in a place where it is safe to dig.

Dig up a small piece of the soil. Do you see the roots of grasses or weeds in the soil?

Take a piece of soil as big as your two hands. Put it in a flat dish in a sunny window. Water it when it needs water. Watch it every day. Watch to see if the grass will begin to grow again.

Plants Do Not Grow during Winter's Cold

Did you ever stop to think how funny it would be if children stopped growing in the wintertime? How funny it would be if they could grow only in the warm days of spring and summer!

Plants do not grow as people do. Think of the trees, the grass, the wild flowers, and all the plants which spend the year out of doors. These plants can grow only during the warm parts of the year.

Most perennials can live during cold winter weather, but they cannot grow during that time. In one way plants are like animals. In winter they are in greater danger from starving to death than they are from freezing to death.

We know that the food of green plants is made by the plants themselves. We know, too, that water is drawn up out of the ground through the roots of the plant. It is used in making food in the leaves, and in carrying food through the plants. In winter, the water in the ground often becomes hard ice. Roots cannot draw up a piece of hard ice. In cold winter, no water can be taken up through the roots to flow through the stems and branches to the leaves. Then the plant can make no food for itself.



In freezing winter, plants cannot make food for themselves.

Read to find out why this is so

One of two things may happen when this cold time comes. Some plants die, leaving seeds to make new plants of the same kind for the next year. These are annuals. Other plants live on the food which has been stored away in one of their parts. These are the perennials.

THINGS TO THINK ABOUT

We often say that plants look dead during cold or dry times of year. When the plant looks that way we know that it is resting.

But it is resting only until the time when it will be able to grow again. As soon as a warm time comes or as soon as moisture is given to these plants, they begin to grow.

Most plants grow very easily. All they seem to need is moisture, light, and the right kind of soil.

About Seeds

HOW WONDERFUL A SEED IS!

Did you ever see lettuce seeds? They are little black things about as large as the point of your pencil. Just one of these tiny specks will grow into a big head of lettuce. Think of the many things for which a head of lettuce can be used.

Jean's sweet-pea garden was a lovely rainbow of blossoms. She picked them every other day. She took handfuls of them to her grandmother. She gave handfuls of them to her friends. She took baskets of them to sick people. Her mother always had a big dish of sweet peas on the table.

These hundreds of lovely flowers came from just a pocketful of seeds!

A great oak tree grew in the garden beside Jean's house. It was so tall that its branches reached much higher than the roof. Its shadow was so big that Jean's family and the neighbors could gather there on summer afternoons. Its trunk was very big around. Jean and Alice could hardly touch hands when they tried to reach around the tree.

The girls used to play with the acorns which fell off the tree. Sometimes they played that the acorns were dolls' teacups.

Jean's grandfather told her that this big tree was once a little acorn no bigger than the end of her finger. Jean thought about this a little. Then she said, "It does not seem as if such a thing could happen, does it? The seed is so small, and the tree is so big!"

She tried to think of putting the great tree back again into a shell no bigger than an acorn. That was too hard even to think of, because the tree had grown so much from the time it was a little seed.

Seeds live on and on year after year. Sometimes they stay in the ground for years and years. At last warmth and moisture reach them at the same time and they begin to grow.

One day Mrs. Davis took some seeds from the flowers in her garden. She put the seeds in a paper and left them in the storeroom upstairs. Years later someone found them and planted them. The flowers which grew from these seeds were as beautiful as the flowers from which the seeds were taken years before.

How wonderful a seed is!

THINGS TO DO

Look at some turnip seeds. Does it seem as if one of these hard, brown things could ever make a meal for hungry boys and girls?

Look at some tomato seeds. Does it seem as if one of these seeds could make tomatoes enough to fill a basket? And in each tomato there are many, many seeds!

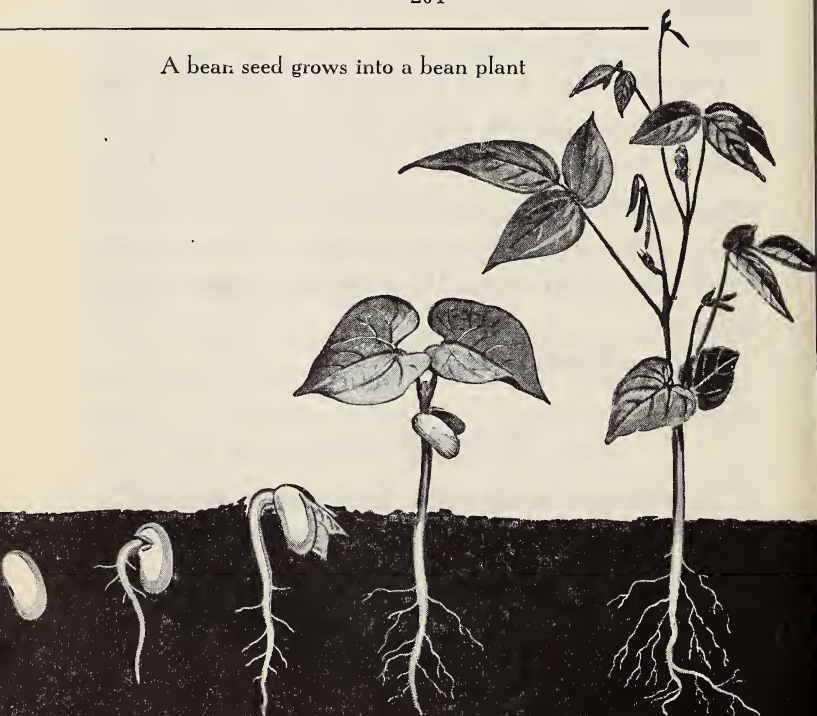
Look at the seeds of a dandelion. Just one of these tiny seeds will make many dandelion plants. Of course one dandelion seed will grow into one dandelion plant. But the blossoms on that plant will have many, many seeds. So the one seed really will make many, many, many plants.

WHY PLANTS HAVE SEEDS

A plant has seeds so that there will be more plants like it. Each year new plants are needed in the world.

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A bean seed grows into a bean plant



You know that an annual dies at the end of the summer. Sweet peas, petunias, marigolds, lettuce, radishes, and the rest will die when autumn comes. But even though they all die, there will be plenty of these kinds of plants in the world the next summer.

Before an annual dies it makes seeds. These will make the same kind of plant grow another year. It will not be the same plant, remember. The seed will grow into a new plant with new roots, new stems, and new branches all its own.

Perennials too have seeds. Although perennials keep on growing year after year, they need seeds just the same. Seeds are not needed to keep the same plant growing year after year. They are needed to make new plants of the same kind. New perennials as well as new annuals are needed every year. Can you tell why?

One thing is very sure to happen to growing seeds. The plant which grows from a bean will be a bean plant. If you plant lettuce seeds in your garden, you will have lettuce plants. Radish seeds become radish plants.

We can be sure that the new plant will be much like the mother plant. It must be, because one of the parts of the seed is the beginning plant. It is there in the seed before the seed leaves the mother plant.

THINGS TO DO

Take some seeds from a plant in the fall. Plant those seeds in the spring. Watch to see whether the new plant looks like the old one.

WHERE TO LOOK FOR SEEDS

When Jean was learning how to care for her sweet peas, her grandfather said, "Be sure to keep the blossoms picked. When the seed pods form, the flowers will not be so fine."

Where would Jean look on the plant for seed pods that were beginning to form?

Where should you think the seeds of other plants would begin to grow?

The seeds of a plant are always formed in the

flower. When the flower dies, we say that the plant is "going to seed."

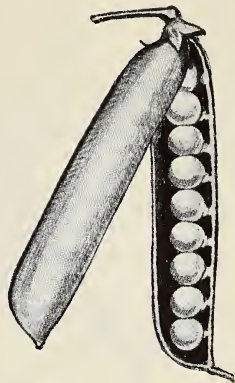
And this is true of all seeds. The seeds of little radishes, big pumpkins, little forget-me-nots, or big lilies, all have their beginning in the flower of the plant. When the flower dies, we begin to see the seed part.

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A sweet pea is going to seed. Can you see the tiny pod where the new seeds will be?

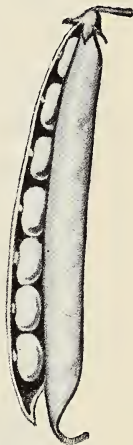


The seeds of some plants form in a seed pod, and so it is easy to tell where the seeds are. Sweet peas, green peas, string beans, and other plants hold their seeds in pods.

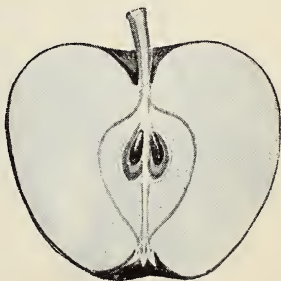


In other plants the seeds are hidden away. Sometimes we have to look deep inside a plant's fruit to find the seeds. The seeds of apples, pears, peaches, plums, and tomatoes are protected in this way. Did you know that the hard "stone" of a plum or a peach is its seed?

Some seeds have such a hard covering that you have to use a hammer or nutcracker to open them. These are the nuts. Walnuts, butternuts, and many other nuts have these hard coverings.



As the nuts lie in the ground, changes take place in these coverings. Then the seeds are able to break through them. They break through and grow into little plants. Many of these little plants grow into trees, which have more nuts like the one from which the little plant grew.





Oats

Other seeds are covered by only a thin skin. You can find these seeds with thin skins very easily. Wheat, rice, oats, and many other grains have seeds with this kind of covering. The seeds are the part of the grain plants which people need most. People grow the grain because they want the seeds for food.

All trees have blossoms and seeds. We all know the beautiful pink blossoms of peach and apple trees and the snowy blossoms of pear and plum trees. Did you ever see the blossoms of maples and oaks? They are harder to find, because they are green like the leaves. Did you know that most of our large forest trees have blossoms?

Maple seeds



Do you know the pretty winged seeds of maple trees? Acorns are the seeds of oak trees. The seeds of a mountain ash and the bittersweet are found in the orange berries which grow in great bright bunches among the green leaves. The hard walnuts are seeds of walnut trees. Butternuts are seeds of butternut trees.

The seeds of all plants are well protected in one way or another. They must be protected so that they will have a chance to grow.

The seed is a much needed part of any plant. Without seeds many, many kinds of plants could not keep on living in the world.

THINGS TO THINK ABOUT

1. What plants can you name which are grown just for their beautiful flowers?

2. Cut an apple or a pear in half—across, not up and down. See how beautifully the seeds are placed in a little flower shape.

3. What seeds, besides those which the book tells about, are protected by a covering of fruit?

4. Can you name any other seeds which are protected by a hard shell?

5. Can you think of any other way by which the seeds of plants are protected?

6. The seeds of many plants are hidden away so carefully that they are very hard to find. How do you think this helps these kinds of plants to keep on living on the earth?

HOW SEEDS ARE SCATTERED

Suppose all the hundreds of acorns on an oak tree should drop straight down to the ground under

the tree and plant themselves there. What do you think would happen?

Would there be light enough under the mother tree for all these young trees to grow up? Would there be room enough in the ground for their roots? Would all of them be able to make food from the soil where they were growing? What do you think might happen to the parent tree?

Suppose the thousands of seeds of a dandelion plant should fall straight to the ground under the plant. Suppose they were not carried anywhere and everywhere by their tiny white sails. Would there be so many dandelions as there are in the world if that were true?

Plants must have enough light and food and room in which to grow. To get these three things, seeds must be scattered far and wide.

There is not enough food in any one spot for a family of animals. Animals can move about from place to place to find food. But plants cannot move themselves from the place where they start to grow. Because there would not be enough room for the plant and all its seeds to grow in one spot, the seeds must move on to another place.

Seeds are carried to their growing places in many ways. Some of them are carried miles and miles from the mother plant.



The seeds of the burdock and sticktight are carried far and wide

You have seen seeds of the dandelion and milkweed carried about with the wind in their soft, white sails. Seeds of maple trees have two wings and look like butterflies. They go whirling through the air far away from the mother tree. The ash has only one wing for its seed, but it sails quite as far as the maple seed.

People scatter seeds in many ways. The farmer, the vegetable gardener, the boy or girl who takes care of a flower garden, all plant seeds with great care.

Many times boys and girls carry seeds about without knowing it. Did you ever find seeds on your



clothing when you were walking through weeds? Burdocks and sticktights have little claws or hooks. These help them to take long rides on the fur of animals and on people's clothing. People who go nutting in the woods often drop some nuts on the



way home. Many times these nuts get pushed into the ground. When warmth and moisture reach them in the spring, they may come up as tiny little trees.

Do you ever walk along a path where weeds are growing? You often knock the seeds off the plants, scatter them, and plant them without thinking about it at all.

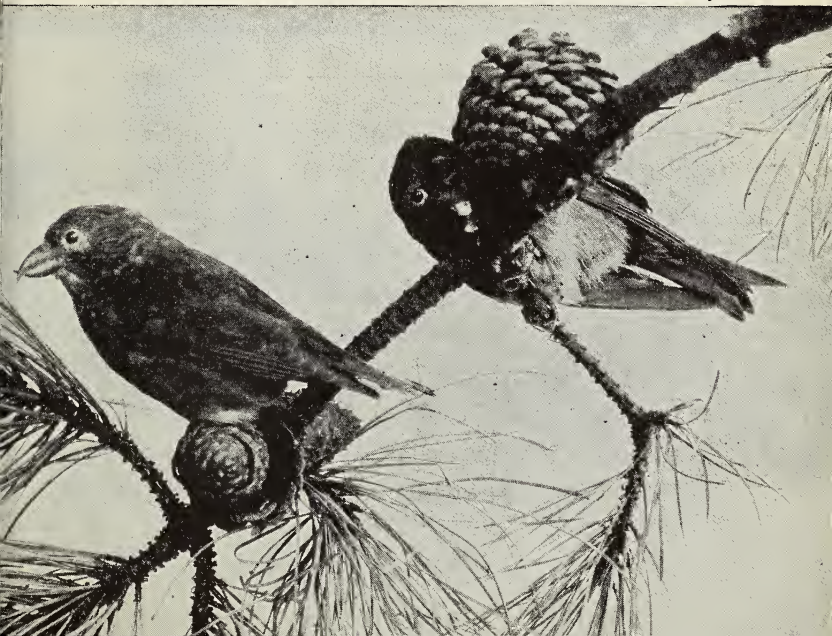
A squirrel hides a nut in the ground for his winter store. He may forget about it, or he may not need it for food. Perhaps it is never found and eaten. Then it is quite likely that a plant will grow from it. This little plant may grow into a nut tree.

Many seeds are scattered from evergreen cones by the birds which like them for food. As the birds pick the seeds from the cones, many seeds are dropped to the ground. Other birds like the bright berries of the bittersweet and mountain ash. They often let the seeds drop to the ground as they eat the fruit. Many seeds grow after they have passed through the bodies of birds.

When seeds form in the tumbleweed and Queen Anne's lace, the blossoms become brown and dry. They curl up into a ball. These balls stay on the

Read to find out how crossbills and other birds help to plant seeds

American Museum of Natural History





The tumbleweed and the Queen Anne's lace
go rolling and blowing over the snow

plant until the stems are old and break easily. At last the wind breaks them off. Away they go, tumbling and rolling over the fields. Sometimes they roll around over the tops of snowbanks. When the snow melts, the seeds go into the ground. The seeds often are planted miles away from the place where the plant grew.

The seeds of other plants shoot far and wide. The witch-hazel pods break open with a loud noise. This sends the seeds far away, as if they were shot from

a gun. The pods of the jewelweed break and curl up like little worms. This throws the seeds far away from the plant.

Water ash and many other kinds of plants grow at the sides of streams and lakes. Their seeds drop into the water. Some of them sail on the water like little boats. Others look more like the water spiders which swim around on the top of the water.

The seeds of plants are scattered in many ways. When you are out of doors, you may be surprised to find how many of these ways you can see.

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Some day you may hear the witch hazel plant its seeds.

Read to find out how witch hazel and jewelweed plant their seeds





The seeds of the water ash and the alder are sent to a place where they can grow

THINGS TO THINK ABOUT

Hundreds and thousands of the seeds which are carried about never find any place to grow. Many of the seeds which do get themselves planted do not grow. Is this a good thing or is it a bad thing?

You know what would happen if all the animals should live to grow up. If all the seeds of all the plants should live to become fully grown, the world would soon be full of plants. There would be no room for people or houses or stores or anything but plants. After a while there would be no room for the plants themselves. They would

not be able to get enough light. They could not make enough food. What a world this would be if all the seeds of all the plants should live to become fully grown!

THINGS TO DO

Watch for growing seeds when you are out of doors. They grow in many different kinds of places.

In the spring you can see hundreds of tiny maple plants coming up under the maple trees.

Did you ever see a rock garden growing in a stone wall?

Have you ever seen grass or weeds growing out of the roof of an old barn?

Seeds find many strange places to stop in their travels. Many of them grow into strong plants.

Many seeds reach the end of their journey in places where they cannot grow. Some seeds soften and become a part of the soil.

VII

Waters of the Earth

ANIMALS MUST HAVE WATER

OUR BODIES MUST HAVE WATER

WHAT WOULD PLANTS DO WITHOUT WATER?

DISSOLVING THINGS IN WATER

EVERYBODY knows that people could not get along in this world without water. It is fun to see how very useful water is in the lives of people. Did you ever make a water chart?

At the top of your paper write *When Did I Use Water Yesterday?* Then write all the different ways in which you had anything to do with water during that day. Have your chart begin with getting up in the morning. Have it close with going to bed at night.

Try to remember how many times you washed your hands or took a drink. Put down the times other people used water in doing things for you, such as washing your clothes, and so on. If you played in water, put that down too. You will have a long chart in a very short time.

Read what you have written to the rest of the class. You will see that there are several things that everyone does with water. Put a cross beside the things which most of the other children did, too. What are they?

Could your day have been very well spent without plenty of water?





Animals Must Have Water

You have told many of the ways in which people need water. What are some of the ways in which animals need water?

We all know how very much animals need to have water to drink. Did you ever forget to leave water for your cat or your dog or your canary? Can you

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George does not forget that his pets need plenty of fresh water

Roberts



remember how sorry you felt to see the animal so uncomfortable?

Do you remember how quickly your pet drank the water which you gave him at last and which he needed so badly? Animals are like people and plants. They must have water to drink.

Most animals like to get their bodies into water. They seem to enjoy it as much as you enjoy having a bath. Watch the sparrows in the street when they find a puddle of water on a hot summer's day! What a splashing a canary makes when he takes his bath in his little dish! And dogs! What fun they seem to have when they play in the water!

On summer days, out in the fields, cows and horses stand in the water for hours. The water helps to make them feel cool and comfortable.

In the dry places of our country, cattle used to die of thirst when the summer was very dry.

But today cattle in these dry places do not die as they did years ago. Wells have been dug, deep down under the ground. There are many wells on these big dry farms.

Windmills pump water from these wells. Some of the water is pumped into large water holes. Here the cattle can have plenty of water to drink. Here they can stand and cool their hot, dusty bodies. The water holes save the lives of many animals.



Read to find out why these animals spend most of their time in the water

Some animals make their homes in the water or at the water's edge. Beavers, muskrats, and otters do this. The water is their place of safety. Can you tell why it is?

Many animals need to stay in moist places so that their skin will not become too dry. Snakes, toads, frogs, and turtles are likely to be found in shady places where there is a little moisture. Toads often crawl into the ground where it is moist and cool.

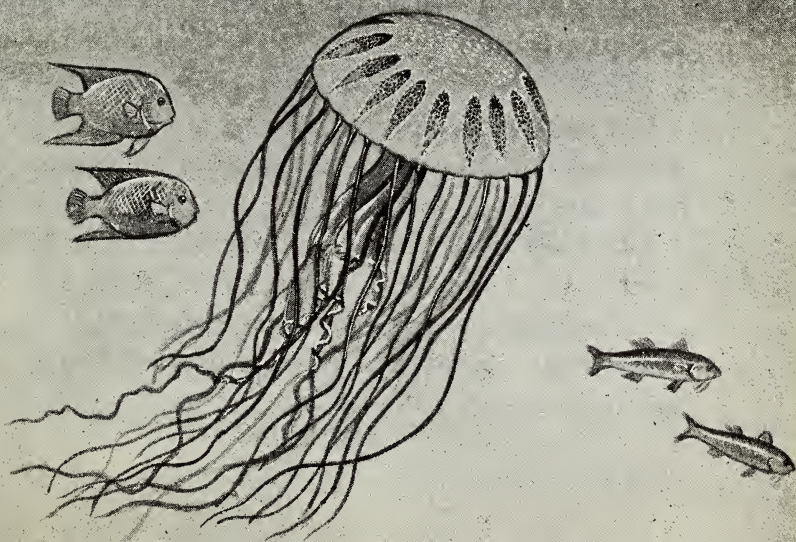
Of course fish spend their lives in water. Fish cannot breathe the air which we breathe. They can breathe only the air which is in water.

Some animals dry up when they are taken out of water. Did you ever see jellyfish? They look like large pieces of white jelly in the water.

Did you ever leave a jellyfish on a board in the sun? Did you ever look for your jellyfish after a few hours and find it gone? Jellyfish dry up if they stay in the air. Almost nothing is left to show that a jellyfish was ever in that spot. The body of a jellyfish is almost all water.

All animals must keep water in their bodies if they are to live. Even animals which live in very dry places must be able to keep water in their bodies.

The body of a jellyfish is almost all water





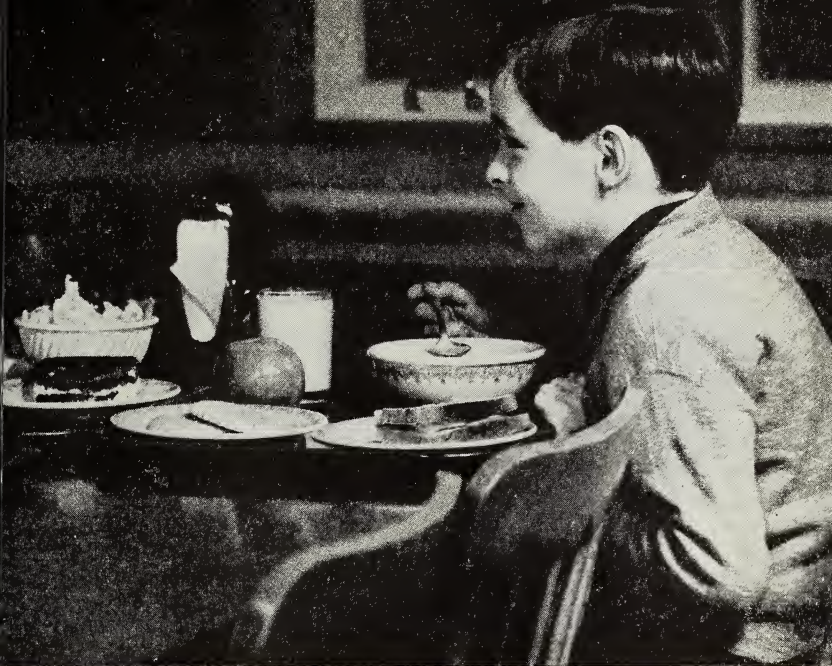
Doris Day

These children are taking water into their bodies

Our Bodies Must Have Water

Our bodies, too, are mostly water. If every bit of water could be taken from our bodies, very little of our bodies would be left.

You know about some of the water that is in your body. Think of the water that comes out of your body through your skin. What a lot of water your body gives off through your skin on a hot summer day!



through different kinds of foods. How many such foods do you see?

Think of the water in your mouth. This is very useful to you. You could not eat your food without the water that is in your mouth.

What about the tears in your eyes? What a lot of water comes out of your eyes when you cry. Did you ever have a bit of dust in your eye? Tears help to wash such things out of your eyes.

And your nose! When you have a cold you must always have a handkerchief ready. You need to take care of the water which runs through your nose.

Water helps to make our blood. The greater part of the blood is water, in which many things are carried. One of the things which the blood carries is food. The blood carries food to all the different parts of our bodies.

All parts of the body have water. There is water in the muscles, in the stomach, in the bones, in all parts of the body.

We must take much water into our bodies to give them the water they need. We take water into our bodies through the things we drink. Everyone needs to drink plenty of fresh water. Most children drink a glass of milk with each meal. Many people drink orange juice, tomato juice, or other fruit juices.

We take water into our bodies through the food we eat. Nearly all foods hold some water. Meat, bread, butter, milk, vegetables, fruits, all have water in them. Can you think of any food that does not have some moisture in it? Even very dry foods become moistened with the water that is in the mouth.

People must have water to keep well and strong. People are like the other animals. They can get along without food better than they can get along without water.



What Would Plants Do without Water?

What happens to your plants if you do not water them?

What has to be done to a garden during dry weather? Do you think the boy and girl in the picture on page 225 are taking good care of their garden?

What happens to the farmer's hay or grain or vegetables when there is little rain during the summer?

Plants must have water. They need it because so much of the plant is made up of water. Water is found in all parts of plants. It is found in leaves, flowers, stems, roots, fruits, and seeds.

Hold a leaf as tightly as you can in your fingers. Are your fingers wet from the moisture that is in the leaf? You will find that this is true, also, with almost any kind of flower.

Stems hold much moisture. Break apart the stem of a dandelion. See how wet it is inside. See the "milk" which comes out. Milkweed takes its name from the milk-like juice that is in its stem.

A tree trunk is a stem. Maple sirup is made from the sweet water that runs through the trunk of a maple tree.



Galloway

This sweet water from the maple trees will be boiled down to make maple sirup

Can you think of other stems which hold much moisture?

Pull up some grass or some weeds by the roots. Look at these roots. Cut them across with a knife. Can you see the moisture that is inside? Can you feel it?

Vegetables may be almost any part of a plant. Carrots, beets, turnips, and radishes are roots. They hold much moisture.

Take a thin piece of a beet or a turnip. This feels wet on your hand. Rub it on a piece of wood or glass. See how much moisture is left there.

Potatoes are really a part of the stem of the plant. Leave a thin piece of potato in the sun to dry. See how long it takes the piece of potato to become really dry.

Celery too is a stem. You can feel the moisture in celery when you eat it.

Cabbage and spinach are leaves. Cauliflower and broccoli are flowers. Peas and beans are seeds.

All vegetables hold much water. Many people cook them with only the water that is already in the vegetable itself.

Of course we know that there is much water in fruits. We drink the juice of oranges, tomatoes, lemons, and many other fruits.

Where do you think watermelon gets its name? Eating a piece of watermelon when you are thirsty is almost as good as taking a drink of water.

One reason we enjoy eating fruits is because of their good juice. They help to give us the water which our bodies need.

All of these things show that there is much water in plants. Can you see why plants must have water to make them grow? Sunlight, air, and good soil are not enough. Plants also must have water.



French Colonial Government

Read to find out why these trees and vines grow so close together

PLANTS IN WET COUNTRIES

In some countries there is so much heat and so much rain that plants grow very fast. Trees and other plants grow very close together.

Sometimes people want to go through a forest in these countries. They have to cut a path because the trees and other plants grow so close together. If someone tries to follow the path a few days later, he can hardly find it. The plants have grown so fast that they have filled the path.

PLANTS IN DRY COUNTRIES

Some other countries are very hot, but few plants grow there. The reason is that these places have almost no rain. These places are called deserts. Most plants cannot grow on deserts, because the ground is so dry.

Some plants can grow there even though it is so dry. Cactus plants can live there. They do not live without water, however. On the outside of the plant is a thick, hard covering. Water is stored up for a long time inside the plant. Travelers on the desert can cut open some kinds of cactus plants and drink the water which is inside.

Some of the best soil in the world is found in desert lands. The only reason food plants do not grow there is because there is not enough water for them.

In some dry places, people have been able to bring water from mountain streams. This water is carried for miles and miles across the land. By bringing water to the desert, people have been able to grow food plants where they could not be grown before.

If you should go to some parts of our country, you would see all kinds of fruit and nut trees. You would see miles and miles of orange trees, lemon trees, walnut trees, fig trees, and peach trees. In the



Galloway

Read to find out why trees and other plants do not grow in this sandy place

days before people were able to bring the water from the mountains, however, much of this land was a dry, dusty desert.

Everything but water was there to make plants grow. But the trees could not grow without water. At last water could be brought there. Now these dry places have some of the greatest fruit farms in the world.

In every place where plants grow on the earth, they must have water. Without water, plants could not go on living.

Dissolving Things in Water

There is an old story about a donkey who was often given loads that were very heavy to carry.

One day the donkey was carrying a heavy load of salt. He had to cross a stream of water. The poor donkey's feet slipped on the stones, and he fell down into the water.

When he stood on his feet again and lifted his load out of the water, he went on with his journey. To his great surprise his load was much lighter than it had been before he fell into the water.

The next day the donkey was carrying a load of sponges down the same road. When he came to the stream, he remembered what had happened to his load the day before.

He walked to the middle of the stream and sat down in the water. When he stood up, he thought that his load would be lighter, just as it had been the other time.

Think how surprised he must have been when he found that his load was much heavier than it was before!

Can you tell why the donkey's load was lighter when the water was mixed with his salt?

Can you tell why it was heavier when the water filled his sponges?

We say that water *dissolves* some things. This means that the salt mixed with the water when the donkey's heavy load slipped into the water. When we dissolve salt or sugar in water, the salt or sugar mixes with the water. We cannot see the salt when it is dissolved, or mixed with the water.

Put a stone and some salt into a glass of water. Let the glass of water stand for a little while. What happens to the salt? What happens to the stone?

When you make lemonade, what happens to the sugar? Sometimes you have to move the sugar

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Susan asked, "How many of these things will dissolve in water?"

Can you tell her?

Doris Day



about for a while, because it drops to the bottom before it dissolves.

When we put sugar into hot water, it dissolves very quickly. It dissolves more quickly than it does in cold lemonade. A hot liquid dissolves things more quickly than a cold liquid does.

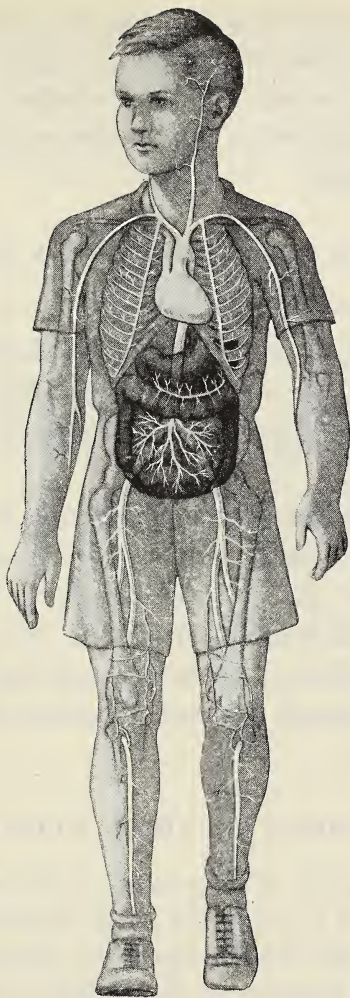
Salt dissolves very easily. But sometimes we find that some of it has dropped to the bottom of the glass. This happens because we have put more salt into the water than the water can really hold.

Can you think of some other things which can be dissolved in water?

HOW THE BLOOD CARRIES OUR FOOD

You know that our blood carries food to different parts of our bodies. Do you know how this is done? The food which we eat is dissolved in the body and is carried about the body by the blood.

Do you suppose any boy or girl as old as you ever thinks that spinach is carried to the bones in the little green pieces into which it has been chewed before it is swallowed? Do you think any child believes that meat and potato are carried to the muscles in small brown and white pieces? How thick our blood would be if this were so! The blood carries food which already has been dissolved.



These white lines show how the blood carries
food to different parts of the body

Food is dissolved in the body very much as sugar and salt are dissolved in water in a glass. The blood carries food to your bones and muscles. This blood is as clean and red as the blood you see when you cut your finger.

DISSOLVED THINGS ARE A PART OF THE WATER

Things which are dissolved in water become a part of the water. We know they are there. Sometimes we can taste them. Sometimes we can smell them.

Can you name a liquid which gives a very sweet smell? Some liquids have a very bad smell.

Sometimes the color of the water shows that something has been dissolved in it. But more often the water looks as it did before anything had mixed with it. Whatever has been dissolved is now a part of the water.

THINGS TO THINK ABOUT

Water seems to be everywhere on the earth. It is in our food. It is in our bodies and in the bodies of other animals. We find water in plants. It is found deep in the ground. It is found on top of the earth in lakes, rivers, oceans. We know that there is water in air. Water is high above the earth in clouds.

Since there is so much water on the earth, it may seem strange that people are often in great need of water. At times, some parts of the earth have too much water. Other parts do not have enough. But most places on the earth do have water at one time or another.

THINGS TO DO

1. Tell some of the ways by which plants, people, and other animals are able to get the water they need.

2. Write a story about a child who tried to go through life without ever touching a drop of water. This child would get into a lot of trouble, wouldn't he? Some very funny things might happen to him, too. Don't you think you can make up a very good story about this child?

VIII

The Air around Us

WHAT IS AIR?

FIRE MUST HAVE AIR

THERE IS WATER IN THE AIR

AIR IS A GREAT PUSHER

CAN you see air? What do you think air is? Do you think air has color? Can you touch air? Can you move it?

Look all about you. See if you can find a place where there is no air. Do you think you can get away from air? Do you think you could live very long without air? Why not?

Air has many uses. It carries many things. It carries clouds from one part of the earth and sky to another. It carries away dust and smoke. It blows leaves about.

Air has many other uses. Can you tell what some of them are? You can read about some uses for air in "The Air around Us."





What Is Air?

At the corner of the street stood a new house. No people had moved into it. No chairs, no tables, no beds had been placed inside.

One day Henry said to Jack, "When I passed by that new house on the corner today, every room was filled to the top with something."

"What was it filled with?" asked Jack. "When I came past I didn't see anything at all."

"Neither did I," said Henry. "But it was full just the same."

"Full of what?" Jack asked.

"Full of air," said Henry.

"Air isn't anything, so there!" cried Jack. "Air doesn't fill up a room in a house or anything else!"

"Yes, it does. I can show you," said Henry.

Do you think Henry played a good joke on Jack?

or

Do you think that Jack was right? Should you say, as he did, "Air isn't anything"?

DOES AIR TAKE UP ROOM?

Here is something that you can do to help answer this question. When you have tried it, you will know whether Jack was right or whether Henry really had



Doris Day

Do you believe that Henry can make this cork
go to the bottom of the bowl without touching it?

played a good joke on him. Henry had done this just before he tried to play his joke on Jack.

Fill a pan full of water. Put a cork on the water. Take a drinking glass. See that it is empty. Turn it upside down. Then push it down quickly into the water over the cork and hold it there.

See where your cork is! It is no longer bobbing about on the water near the top of the pan. It is still on the water, but it is close to the bottom of the pan.



Doris Day

The glass was empty. Read to find out
what pushed the cork to the bottom of the bowl

The water outside the glass is higher than the water inside it.

Now take the glass out of the pan. See where the cork is now. It is sailing on the water near the top of the pan just as it was before.

Try the same thing again. Does the cork go to the bottom of the pan each time you push the glass down over it? And does it bob back again whenever you take the glass away?

As you put the glass down over the cork, something seems to be pushing the water out of the way. It is air. Air was in the glass before you put the glass into the water. There was not enough room in the glass for both the air and the water. The air kept the water from going into the glass.

Now what do you think about Henry's joke on Jack? Air takes up room in a glass. Would it take up room in a house?

Probably everyone will say that Henry knew what he was talking about. Air is not "just nothing." Air takes up room. We can feel air. We can hear air. We can breathe air.

WE CAN FEEL AIR

We can feel the warm air that is around a hot stove. We can feel the freezing cold air when it bites our noses and fingers on a winter's day.

Wave your hands back and forth through the air. Can you feel something which you could not feel when your hands were still?

Wave a fan back and forth. Everyone who is near you feels the air very easily now.

Paper, feathers, and all very light things move about when you wave a fan. A toy boat will ride all over a pan of water when the fan makes a wind

to blow it about. The fan moves the air, and the moving air pushes the boat along. It is the moving air that makes papers, feathers, and other light things move about.

You surely can feel air when it moves so fast that your hat blows off. Wind and moving air are the same thing. Sometimes the wind blows so hard that you can hardly walk against it. You know that you can feel air when you try to walk against such a hard wind.

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Moving air from Susan's fan pushes the boat across the pan of water.

Read to find a name for moving air

Doris Day



WE CAN HEAR AIR

We can hear air moving about when we hear the wind blow. We can hear the wind as it shakes the trees. We can hear it whistle down the chimney and through the cracks around a door. Sometimes a strong wind blows trees and fences down. This air sounds as if it were an angry giant as it hurries past. Sometimes it roars about, high over our heads. Then it seems as if it were trying to find out how much noise it could make.

CAN WE SEE AIR?

No, we cannot see air. We can see things that are in the air, but we cannot see air itself.

Some children think that air has color. They say, "The sky is blue."

We know that the sky is just the air as we look up into it. It is true that the sky looks blue. It looks blue because of dust and water which are always found in the air. These reflect the blue rays of the sun.

In some places on the earth the air has little dust or moisture. In some of these places people can see for more than a hundred miles. When you look off to far-away places, they seem to be blue. They seem blue for the same reason that the sky seems blue.

The tiny bits of dust and water in the air reflect the blue rays of the sun.

On a cloudy day, the air looks gray. Sometimes fog comes close to the earth. Then the air looks white. The air looks gray or white because it is holding so many tiny drops of water.

WE MUST BREATHE AIR

Try to get along for a little while without taking a breath. You can hold your breath for a short time. Then you must breathe, no matter what happens.

Sometimes a baby holds his breath when he cries. We must do anything we can to make him start

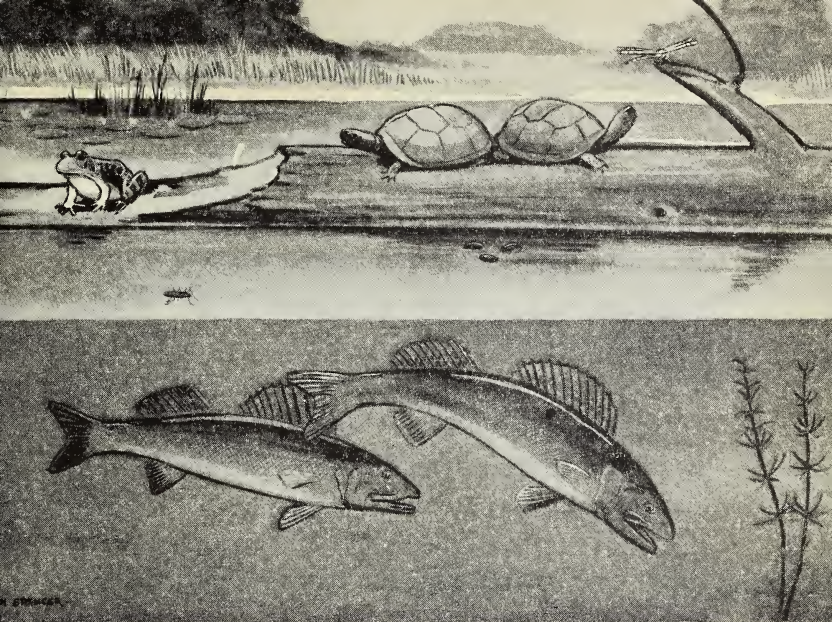
breathing again.

When you play running games you need to stop once in a while to catch your breath

Lang



In playing running games, you "touch home" now and then so that you catch your breath. Hard running makes your body use up air faster than you can take it into your body. You need to stop running once in a while to take in enough breaths of fresh air.



Fish breathe air that is in water. Some animals must come to the top of the water for air. How many of these can you see?

Here is one of the strange things about air: We must breathe it. We cannot get air into our bodies by drinking it as we do water. We cannot take air into our bodies through our skin as a piece of blotting paper takes up water. We have to take air into our bodies by breathing it through our noses or mouths.

Here is another strange thing about air: It is all that we can breathe. We cannot breathe water. We cannot breathe dry land. Some water is in the air. Some dust from the dry land gets into the air. We

breathe in both these when we breathe the air which holds them. But we could not breathe them in if they were not in the air.

People are not the only animals that must have air. All birds, reptiles, mammals, insects, and fish must have air, or they cannot live.

Some animals do not need so much air as others do. Fish use the air that is in the water. Earthworms, moles, gophers, and other animals find enough air under the ground, where they make their homes. But all animals must have some air. They cannot breathe water or dry land any more than people can.

Fire Must Have Air

Some girls and boys were having a picnic. They were going to build a fire and cook their lunch.

"We must build our fire in a safe place," they said.

"Yes," said Alice, "we must build it where there is no dry grass. A picnic fire can spread into the grass and make a big fire."

"And we must see that our fire is not too near the trees," said Bob. "Trees can catch fire if people are not careful."

The boys brought water from the brook. Mary and Alice found some paper and some dry twigs. They put some sticks over these in a pile. They lighted the paper and dry twigs with a match. The fire burned for a few minutes and then went out.

When the boys came back, Mary said, "What is the matter with this fire? It won't burn. Our matches are almost gone, and I am afraid we can't have a fire at all."

Bill said, "You didn't build it right. You just dropped the sticks down any old way. You should lay them down carefully, one across the other, so that the air can go up between the sticks."

Bob said, "A better way is to stand them up on end with the tops touching. The air can go through more easily."



Bill and Bob show Mary and Alice that fire must have air to make it burn

Bill said, "Let's each build a fire and see which one burns better."

Each boy built his fire in his own way. They lighted their fires at the same time. One fire burned as well as the other, because each fire had plenty of air.

Mary kept working at her fire. At last she found a place where the dry twigs would burn a little. She watched that place and fanned it carefully with a big leaf. By and by she had a fire, too.

Mary looked at the three fires. "Now we have plenty of fires," she said. "Let's cook our lunch."

"We shouldn't have had any fire yet," said Bob, "if Bill and I had not known that air makes a fire burn."

"Yes, that's true, all right," said Mary. "We must remember this too: When we get through with these fires, we must put them out carefully. If we should go away and leave them, a little wind could make them burn up the whole woods."

When they had finished eating, Mary said, "I shall put out my fire with this water." She picked up the pail of water in which they had washed their potatoes. She carefully poured the water all over her fire. Nothing was left burning.

Bill said, "Oh look! Mary has used up all the water! Bob, you and I must take a walk to the brook to get more water for our fires."

"I do not need to," said Bob. "I'm going to put sand and dirt on mine."

He dug up big handfuls of dirt and spread it all over his fire. At last his fire was out, too. The dirt kept the air away from his fire.



These children will leave a clean, safe picnic ground

When the girls had washed the potatoes, they had splashed water over the leaves on which the pail was standing. Bill said: "I shall put these wet leaves over my fire. The wet leaves will keep out the air as well as the sand or the water does."

Just to be sure, though, the children brought more water from the brook. They put water on the wet leaves. They all looked to see if each fire was out. Not a sign of fire was left anywhere. There was no chance for the wind to make a big fire. They left a clean, safe picnic ground for the next people who wished to eat there.

THINGS TO THINK ABOUT

1. Of course a thoughtful child would not "play with fire." Why is it not a safe thing to do?

2. Why should you always do your very best during a fire drill at school?

3. If your own house should ever catch fire, here are some things that you could do to help:

a. Shut the door of the room that is burning.

b. Go to the telephone at once and say, "My house is on fire. Please call the fire house." Then tell the name of your street and the number of your house.

If you have no telephone, go to the nearest fire box and send in a signal.

c. Go out of the house and stay outside until help comes.

4. Why should you shut the door of the room where the fire is?

5. If your clothing should catch on fire, never, never run. If you run, the fire will burn harder and faster. If you should run, you would give more air to the fire. Air makes a fire burn.

The best thing to do is to lie down on the ground and roll over and over. This helps to keep air away from the fire.

THINGS TO DO

To show that fire needs air, try this:

Take five candles.

Stand them in a row on a table. Be sure that nothing around the candles can burn.

Light each candle.

Cover the first candle with a drinking glass.

Cover the second candle with a small fruit jar.

Cover the third candle with a large fruit jar.

Cover the fourth candle with a still larger jar.

Do not cover the fifth candle at all.

Watch to see which candle burns longest.

Which candle goes out first?

Which candle goes out next? and next?

Can you tell why the candles go out as they do?

There Is Water in the Air

Have you ever known water to go away from places where people have left it? It has a way of leaving without being touched by anyone.

Put a dish of water in a warm, dry place. In a day or two the water will all be gone. If the air in the room is very dry, the water will go away more quickly. Perhaps you can see a little ring inside the dish where the water was at first.

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Where did the water go when it left the bowl?

Doris Day



Where did the water go? It didn't go through the bottom of the dish, or it would have left a spot of water where the dish stood.

Why do you need to keep putting more water into your goldfish bowl? A little girl once said, "The fish drink it." Was she right? Could there be less water in the bowl when the fish, water and all, are still in the bowl?

We have to watch things that are cooking on the stove to see that they do not "boil dry." Where does the water go when the apple sauce or vegetables boil dry?

Where *does* the water go when it goes away so strangely? Were you able to answer the question any of the four times it has been asked? Do you think the water turns into nothing at all? Do you suppose we could get any of it back if we should try?

The water which went away from all these places went out into the air. We cannot see it, but we know that it is there. We know that the air is holding it. We say that the water evaporates. It has become a part of the air.

Water from rivers, ponds, lakes, and oceans evaporates. Water evaporates from wet clothes on a line when we hang them up to dry. Can you tell about any other places where water evaporates? What are they?



Doris Day

What makes the little drops of water form
on the outside of the glass of ice water?

HOW WE KNOW THAT WATER GOES INTO THE AIR

Put a glass of ice water in a warm room. Soon little drops of water form on the outside of the glass. These little drops have not gone through the sides of the glass, because the glass has no holes in it. They come from the air. The moisture which is

in the warm air turns into drops of water when it touches the ice-cold glass.

For the same reason, little drops come on the windows of an automobile on a cold day when people are riding with the windows closed.

On wash day, or when vegetables are cooking on the stove, the windows become covered with water. The water that cooked away goes into the air. For a time, you cannot see it. Then it is turned back into water that you can see. You can see drops of water when the moist air touches the cold window.

When you take a hot bath, the mirror in the bathroom often is covered with little drops. The hot water evaporates into the air. When it touches the cold glass it turns back into little drops of water again.

It is a good thing that moisture does come back from the air. If the air did not give back its moisture, we should have no rain to water the garden. We should have no dew on the flowers. We should have no snow or frost. The air must give back the moisture which it has taken from the earth.

Water evaporates from rivers and oceans very fast. Without rain and snow to fill them up again, they would soon be as dry as dust. Without rain and snow, dew and frost, the whole earth would soon be as dry as dust.

THINGS TO DO

Plants take up some of the water which you put on them. It goes up into their stems and leaves. Then they throw off a lot of this moisture into the air. That is one reason they need to take in so much water.

If you put a glass jar over a plant and leave it there for a little while, drops of water form on the inside of the jar. This moisture comes from the plant.

If you think the moisture came from the moist earth in the jar, try this: Put some fresh leaves into a bottle. Close the end of the bottle. By and by little drops form on the inside of the bottle. The leaves give off moisture into the air which is in the bottle. The moisture must come from the leaves, for how else would it get inside the bottle?

Air Is a Great Pusher

Air pushes on everything. It pushes on the top, bottom, and sides of everything in the world. It pushes on the inside and on the outside.

Did you ever wonder why the big window of a store does not fall in and break? It is because the air is pressing as hard on one side as it is on the other. If all the air could be taken out of the room, the air out of doors would push the window in as easily as you please. The wind would not need to be blowing to make such a thing happen. Air presses very hard on all sides of windows and of everything else in the world.

Do you know why a fence is blown over by a hard wind? It is because the air is pressing harder on one side of the fence than it is on the other side.

Do you know why you are able to drink milk through a straw? When the straw is standing by itself in the glass, the milk does not come up to the top of the straw. The air pushes as hard against the milk in the straw as it does against the rest of the milk in the glass.

When you put the straw into your mouth to drink, you pull the air out of the straw. Now the air no longer presses against the milk in the straw. But air is pressing against the rest of the milk in the

glass. The air pushes this milk up through the straw into your mouth.

When you take the straw out of your mouth, the milk goes down in the straw. It is no higher in the straw than it is in the rest of the glass. The air has come back into the straw. It pushes the milk down even with the rest of the milk in the glass.

Some children in school were taking care of their goldfish. They saw some large pieces of dirt in the water near the bottom of the bowl.

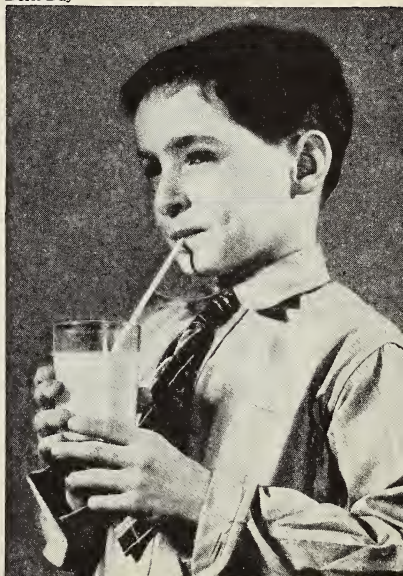
"How can we take these pieces of dirt out of the bowl?" they asked. "They slip right through our fingers when we try to take them out."

Their teacher took a long glass tube. She put the tube over one of the pieces of dirt. The water went up into the tube. The pieces of dirt went up into the tube with the water.

Before she took the tube out of the water, Miss Smith closed it tight by putting her finger over the top end. Then she lifted the tube out of the bowl. The water with the piece

Can you tell Henry what makes the milk go up into the straw?

Doris Day





Doris Day

What makes the water stay in the tube? What will happen
when Susan takes away her finger?

of dirt stayed in the tube. Miss Smith held it over the floor, but not a drop of water ran out of the tube.

"Oh, Miss Smith can do magic!" the children said.

"No," said Miss Smith, "that is not magic. The water stays in the tube because air is holding it there. Air pushes up on the water that is in the tube. It cannot run out."

Then she held the tube of water over a pail and

took her finger away from the top. The water ran out of the tube.

"Now you can take out the other pieces of dirt by yourselves," she said.

Can you tell why the water ran out of the tube when Miss Smith took her finger away?

THINGS TO THINK ABOUT

1. What makes the air go out of a balloon when you unfasten the opening?

2. What makes the air go out of an automobile tire that has a hole in it?

3. What makes a paper bag break open with a bang when you blow it up and then hit it with your hand?

4. Remember, air presses on the inside of things as well as on the outside.

THINGS TO DO

Here are some things to do to show that air presses hard on things.

1. Cut a potato into flat pieces. Press a piece of the potato hard against a plate. See that no air is between the potato and the plate. Turn the plate upside down. Does the piece of potato drop off the plate? Why not?

2. Cut a potato in half. Press it hard against the plate. See that no air is between the potato and the plate.

Take hold of the potato to lift it up. When you lift the potato you lift the plate too. Can you tell why the potato is able to lift the plate?

IX

Magnets and What They Do

THE WORK OF MAGNETS

THE PULL OF MAGNETS

MAKING MAGNETS

THE MAGNETIC COMPASS

DID you ever play with a magnet? What could you make it do?

Where have you seen magnets? What could they do?

Did you ever see a magnetic compass? Who was using it? For what was it being used?

If you have never seen a magnet, you will find this story interesting. You will find out that magnets do very queer things.

If you have played with magnets, you will like to read this story, too. You will find out how other people have used them.





The Work of Magnets

HORSESHOE MAGNETS

One day Alice brought some magnets to school. These magnets looked just alike, but one was a little smaller than the other. They looked like little horseshoes.

"These are called horseshoe magnets, because they are the shape of horseshoes," said Alice.

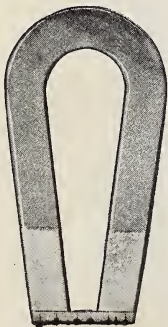
The magnets were painted red. The ends of the magnets were not painted. They were gray and shiny.

A tiny bar of iron went with each magnet. Very slowly, Alice moved a magnet toward its little bar. When the ends of the magnet were very close, the little bar seemed to give a jump. It fastened itself to the ends of the magnet.

Alice's horse-shoe magnet looked like this

The children tried this again and again. It was fun to watch the little bar fasten itself across the ends of the magnet. It took a real pull to get the bar away from the magnet.

Bob put the magnet into a box of little nails. When he took it out of the box, a whole ball of little nails was hanging to the ends.



The children tried to have the magnet lift all kinds of things. It would lift needles, small nails, a small steel spring, and pen points. It would not lift paper, rubber bands, sawdust, or cloth.

"It ought to lift paper and rubber bands," said Mary. "They are lighter than nails."

"Yes, it ought to," said Fred. "But it doesn't. It just lifts things that are made of metal."

"It won't lift my gold ring," said Mary.

"It won't lift these pins," said Bob. "These pins and Mary's ring are both made of metal."

"I know," said Alice. "This is what happens. The pen points are made of steel. The little bar is made of steel, and so are the needles. The nails are made of iron. The magnet lifts them.

"The ring is gold, and the pins are brass. The magnet will not lift them. The magnet will lift iron and steel. But it will not lift most other metals."

"Then if we want to see the magnet lift things we must give it iron or steel things to lift," said Mary.

"This is what Uncle Tom told me when he gave me the magnets," said Alice. "Magnets really lift iron. Steel is a kind of iron. So they lift things which are made of iron or steel."

The children tried all the small iron and steel things they could find. If the things were small enough, the magnet would lift them all.

Sometimes the children made a pile of six or seven brass pins and six or seven steel needles. The magnet would come out of the pile with a load of needles. The brass pins would stay just as they were on the table.

Only things which were made of iron or steel could get a ride on the horseshoe magnet.

OTHER KINDS OF MAGNETS

"The horseshoe magnet is not the only kind of magnet," Miss Smith told the children. "Other kinds of magnets are often used."

Then she showed the children two other kinds of magnets. One kind had sides more nearly straight than the horseshoe magnet. The ends were wider apart.

"This is called a U magnet, because it is shaped like a letter U," said Miss Smith.

The other magnets were straight pieces of steel.

They looked like steel sticks.

This is a U magnet



"These are called bar magnets," Miss Smith told the children. "Each magnet is a bar of steel."



This is a bar magnet

NORTH AND SOUTH POLES

One day the bar magnets lay side by side on the table. Henry started to pick up one bar magnet and found that he had two in his hand.

"Look at this," he said. "These magnets will pick each other up."

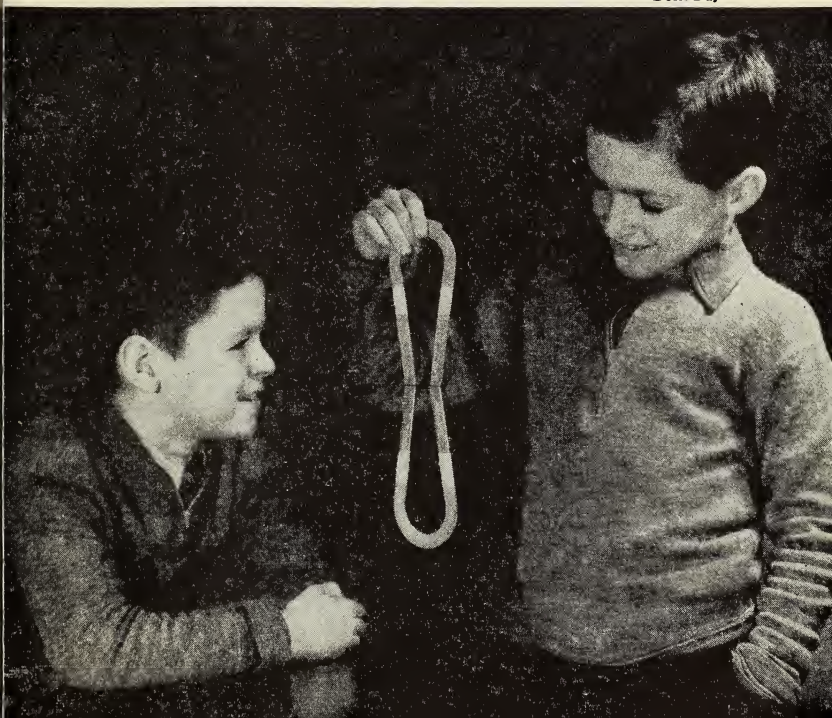
Then he tried two U magnets. If he held them just right, one U magnet would pick up another U magnet. He tried two horseshoe magnets. If he held

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A horseshoe magnet

will hold another horseshoe magnet if you hold it just right

Doris Day



them just right, one horseshoe magnet would pick up another horseshoe magnet.

"Look, Susan and Jack," said Henry. "These magnets will pick each other up."

Then he took one bar magnet in his hand. He laid it beside another bar magnet. This time the magnet did not lift the other one from the table.

"What's the matter?" he said. "Just a minute ago it would pick up the other magnet easily."

"Let me try it," said Jack.

Henry laid the magnet down. Jack picked it up. He put it beside the other magnet. Up came both magnets together.

"There's something funny somewhere," said Jack. "First it works, and then it doesn't, and then it does."

Just then Miss Smith came by. "I think I can help you with this," she said.

Then she pointed to the letters on the ends of the magnet. At one end of each magnet was the letter *N*. At the other end was the letter *S*.

"Lay your magnets so that the *S* end of one touches the *N* end of the other. Then try to lift them," she said.

Up came the two magnets together.

"Now try it the other way," she said. "Put the *S* beside the *S* and *N* beside *N*."

This time one magnet would not lift the other.

Again and again the children tried the two ways of putting magnets together. Each time this same thing happened. When *S* touched *N*, one magnet could be lifted by the other. When the *N*'s were together one magnet would not lift the other.

"This is the reason," said Miss Smith. "*N* stands for north pole. *S* stands for south pole. The north pole can hold only to the south pole, and the south pole can hold only to the north pole."

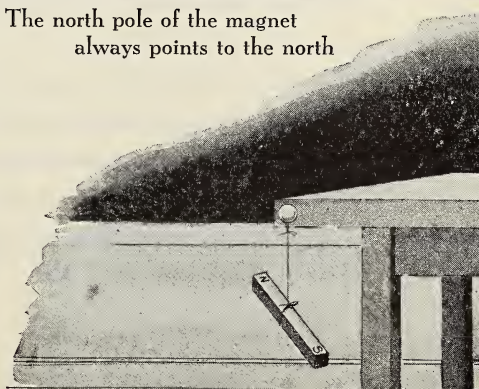
"North pole and south pole sound like the north and south poles of the earth," said Susan.

"Yes," said Miss Smith. "The earth has a north pole and a south pole. It also has a north magnetic pole and a south magnetic pole. The north and south poles of a magnet have something to do with the north and south magnetic poles of the earth."

Then she showed them how this was true. She tied a thin string around the middle of one of the bar magnets. She hung the string on the corner of the table. There was room for the magnet to swing about in any way it would. Nothing touched it.

When the magnet was very still the

The north pole of the magnet
always points to the north



north pole pointed to the north side of the room. The south pole pointed to the south side of the room.

The children hung the magnet in many places. In each place the north pole pointed to the north, and the south pole pointed to the south.

"Miss Smith, do all kinds of magnets have a north pole and a south pole?" asked Jack. "The horseshoe magnets do not have *N* and *S* at the ends. Neither do the *U* magnets."

"Let us see," said Miss Smith. "Try to pick up one horseshoe magnet with another one."

When the ends were placed together in one way, the magnets hung together. When the ends were placed together in another way, the magnets would not hang together.

"What do you think?" asked Miss Smith. "Do horseshoe magnets have north and south poles?"

"They must have north and south poles," said Henry. "That is why they hang together sometimes and drop apart at other times."

Henry was right. All magnets have poles. Bar magnets, horseshoe magnets, and *U* magnets all have poles. The poles that are not like each other hold together. The poles that are like each other do not. They seem almost to push each other away.

Try this for yourself. You will find that the rule for north and south always holds true.

The Pull of Magnets

When you are working with magnets, see if this is not true: Small things made of iron do not always need to be placed on a magnet to become fastened to it. Things placed near a magnet seem to go to the magnet without help.

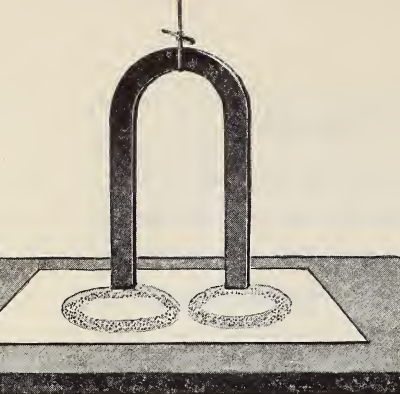
Take a strong magnet. Lay a nail on the table. Slide your magnet slowly toward the nail. As the magnet comes close to the nail, watch what happens. The nail seems to give a little jump. It seems to hop over to the magnet and fasten itself there.

You can try this with many things. Anything small that is made of iron or steel will hop to the magnet when it comes close enough. The magnet pulls things toward itself.

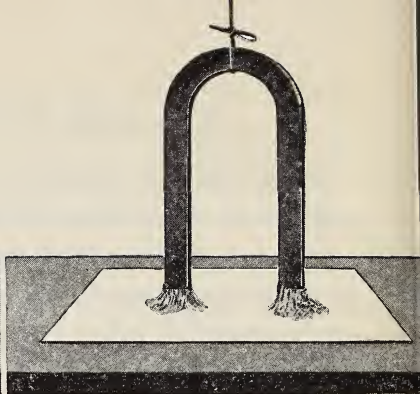
You can see for yourself that there is a place around the magnet where things can be "pulled" to the magnet. This place around the magnet has a name. It is called the magnetic field. Any iron or steel which comes into the magnetic field is pulled toward the magnet.

Iron filings show a magnetic field very well. Iron filings are like iron sawdust. Probably your teacher can get them for you. You can buy them at a store that sells magnets.

Lay some iron filings on a sheet of paper. Hold a



Without touching them, the magnet draws the iron filings together



What happens as the magnet is held closer to the iron filings?

magnet close to the filings. Watch the filings as they seem to jump from the paper to the magnet.

Put the iron filings back on the paper. Hold the magnet near the filings, but not close enough to have them touch the magnet.

Move the magnet around and around over the paper. Watch the filings as they move about on the paper. They seem to follow the magnet around and around. When iron filings do this, they are at the edge of the magnetic field.

Some magnets have a larger magnetic field than others do. A strong magnet has a larger magnetic field than a magnet that is not so strong.

You can measure to see that this is true.

Place a nail on a ruler beside the figure 1. Take a strong magnet. Slide it along the ruler toward the

nail. What figure on the ruler has the strong magnet reached when the nail fastens itself on it?

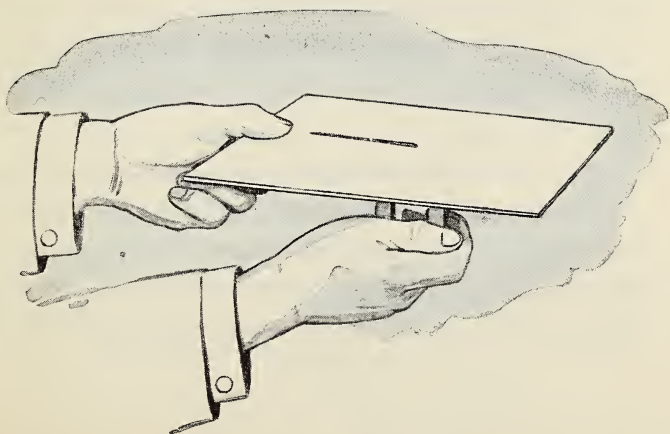
Try the same thing with a magnet that is not so strong. How far does this magnet pull the nail?

A magnet's "pull" goes through the air. It goes through other things too. It goes through cloth. It goes through paper.

Lay a needle on a piece of paper. Now move the magnet about under the paper. Watch the needle as it travels about on the paper. It follows in the path of the magnet. It goes wherever the magnet goes. The pull of the magnet goes through the paper.

Try to find some other things through which the magnet's pull can travel. Put a nail in water. Will the magnet's pull travel through water?

The magnet under the paper pulls the needle about



Making Magnets

MAGNETS THAT LAST

Alice wanted to make her magnet do something that none of the other children had seen. She thought and thought. As she was thinking, she rubbed the needle along the ends of the magnet. She rubbed and rubbed, always in the same way.

Then she laid the needle down on the table. Its point touched another needle.

Mary said, "May I take your needle, Alice?"

When Alice picked it up, the other needle came too.

The girls found another smaller needle. The needle magnet would lift this one too. They tried to pick up other steel things with the needle. Most of them were too heavy for the tiny magnet to lift. But it would carry any needle smaller than itself.

Alice said: "I have found a new thing to do without knowing it. I gave myself two magnets when I had only one."

Then the children found a strong magnet. They rubbed it on a small hammer and made that into a magnet. It would pick up little nails. They made some scissors into a magnet. This would pick up needles. They made many needle magnets.

SHORT-TIME MAGNETS

Sometimes things do the work of magnets, but are not really magnets. A piece of iron that touches a magnet becomes a magnet itself. When it is taken away, it is no longer a magnet.

With a strong magnet, pick up a large iron nail. It is best to use a nail with a large head. Put the point of the large nail into a pile of small nails. The little nails will hold to the big nail as if it were a magnet.

Now pull the big nail away from the magnet. The small nails may stick to it a little while. But soon they drop off. The big nail is no longer a magnet.

You can make many nails into magnets in much the same way. With a strong magnet pick up a nail. Have the head of the nail touching the magnet.

Put the head of a second nail against the point of the first nail. Put the head of a third nail against the point of the second nail. Your nails should look like those in the picture just before page 262.

See how many nails your magnet will hold. Every nail is a magnet. Put some iron filings on your last nail. Even the filings are tiny magnets.

Pull the first nail away from the real magnet. What happens to the rest of the nails?

These nails were magnets for only a short time. Soon after they stop touching the real magnet, they are no longer magnets.

THINGS TO THINK ABOUT

1. One day Fred pushed over the box of nails. What would be the quickest, easiest, and cleanest way for him to pick them up and put them back into the box?

2. Bill's grandmother said: "When I drop my needle, I have such a hard time to find it again! I do not like to lose a needle. Someone may be hurt very badly by a needle which is lying about."

Bill rubbed the points of his grandmother's scissors with a magnet. "This will help you to find your needle," he said. Can you tell how it would help?

3. Can you think of other ways by which magnets could help people to pick things up quickly and easily?

The Magnetic Compass

A COMPASS NEEDLE POINTS NORTH AND SOUTH

Another thing that gave the children a lot of fun was a magnetic compass. This was a little round, flat, brass box with a glass top. Swinging from a pin in the bottom of the box was a thin piece of steel. This looked a little like the hands of a clock when it is six o'clock. One half of the hand was gray. The other half of the hand was dark blue. This hand is called the needle of the compass.

The compass would do a very strange thing. No matter which way the compass was turned, the blue end of the needle always pointed to the front of the room. The gray end always pointed to the back of the room. The children carried it all over the room. But the same thing always happened.

When they went out to play, the blue end pointed to the north side of the playground. The gray end pointed to the

This is a magnetic compass

Doris Day



south side. They walked all around with it, and the same thing always happened. The blue end would turn around until it was pointing to the north, no matter which way the children went.

"It always points at the north out here. Does it point the same way when we are inside?" someone asked.

Miss Smith said that the front of the room was the north side of the room.

"It always points to the front of the schoolroom. Then the blue hand always points the same way. It always points north," the children said. "The gray hand always points south."

THE COMPASS NEEDLE HAS POLES

Do you know why the needle of a compass always points north and south?

The needle of the compass is a magnet. It has poles just as other kinds of magnets have. The blue end of the needle is the north pole. The gray end is the south pole.

The earth's north magnetic pole makes the needle point north. It pulls the needle toward itself. The end which swings north is called the north pole. The other end is called the south pole, because it points south.



Doris Day

The compass tells Jack where to find Susan and Henry

USES FOR THE COMPASS

The children learned that compasses are used in many ways. Men who sail ships out on the wide sea use compasses. People who travel on land have houses, hills, towns, or signboards to show them the way to go. Men on the sea do not have these things. They have to use a compass to know the right way to go.

Some people take long walks through forests. They can tell which way they are going by watching

the needle of a compass. If they want to go north, they must follow the blue hand. If they want to go south, they must follow the gray hand. If they want to go east, they must travel to the right of the way the blue hand points.

The children tried this themselves. They had great fun walking east, west, north, or south by looking only at the compass in their hands.

They also played a game of hide, or hide-and-seek, with the compass. One child would hide.

"Dorothy is east of you," the children would say to the one who was "it."

This child would walk slowly east, looking only at the compass in his hand. He would use no other way to find the child who was hiding. As soon as he saw her they would both race back "home."

A MAGNET CHANGES THE WAY A COMPASS POINTS

One day a strange thing happened to the compass. Henry said: "I'm Daniel Boone going through the woods. Let's see. I want to go west. I shall walk to the left of the way the blue needle points."

As Henry held the compass in his hand, he could hardly believe his eyes. The blue hand was not pointing north at all. It was pointing straight at Henry himself!

"How does this happen, I wonder," he said.

Jack took the compass out of Henry's hand. The blue hand still pointed at Henry. Fred was standing on the other side of Henry. When Fred took the compass, the blue hand turned around till it pointed at Henry again.

"You must be the north magnetic pole," said Jack. "It always points at you."

Just then Henry reached into his pocket for his handkerchief. When he pulled it out, something else came with it. It fell onto the floor in front of Jack. The needle then pointed to the blackboard.

The thing that fell was a horseshoe magnet. When Henry picked it up, the needle pointed at him.

"I thought I was through with being pointed at," he said, as he laid the magnet on the table. Just as he said this, the compass pointed to the table.

"That compass surely does funny things," the boys cried.

"It's that magnet, I believe," said Fred. "The blue needle points wherever the magnet is." He took the magnet from the table, and the blue hand of the compass pointed at him. "This magnet must draw the compass needle the way the north magnetic pole does."

"Yes," said Henry. "The magnet can't be so strong as the magnetic pole is, but it is much nearer



Doris Day

Henry shows how a magnet can move the needle of a compass

to the compass. It pulls more on the compass than the magnetic pole does.”

When the boys took the magnet away from the compass, the blue hand pointed north just as it always had done before.

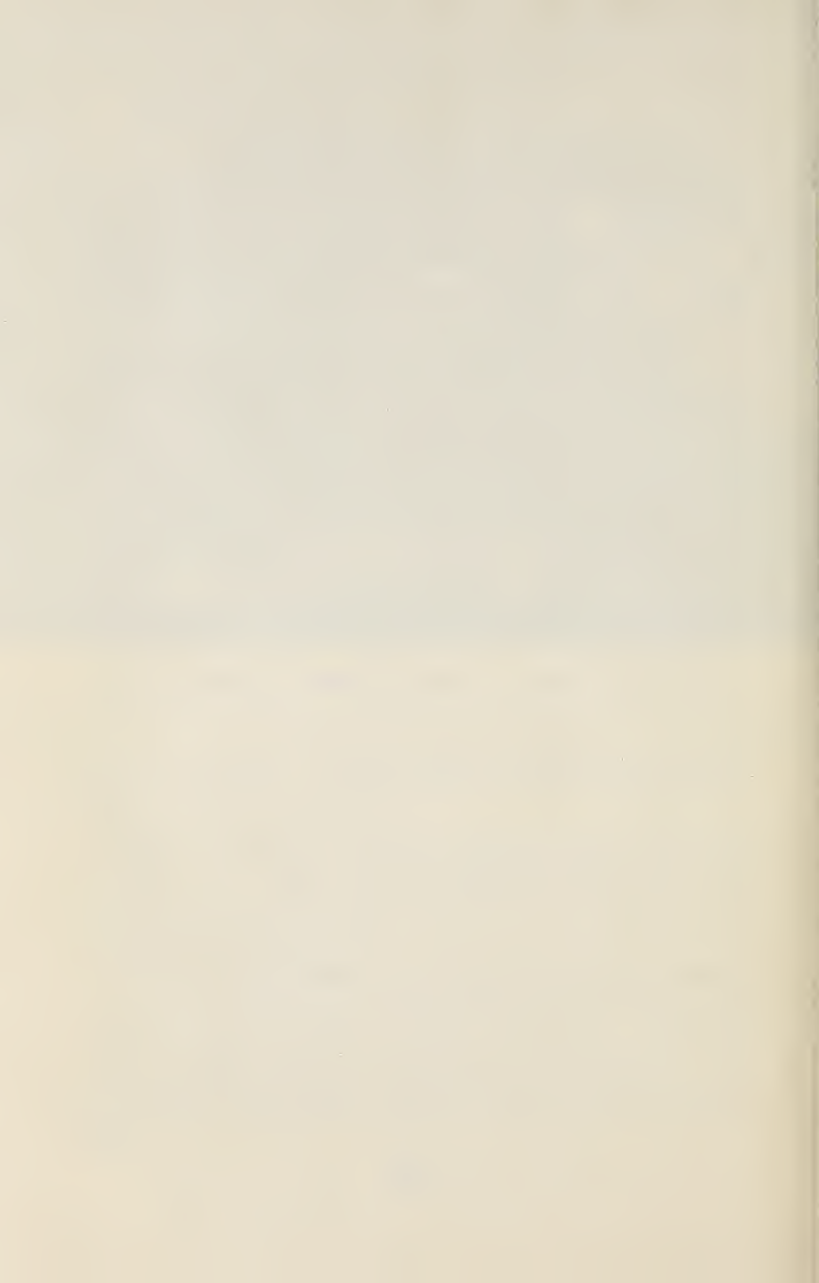
“Well,” said Henry, “perhaps Daniel Boone used a compass to go west through the woods. But I’m sure he didn’t carry a magnet in his pocket. He would not have gone very far west if he had done that.”

THINGS TO DO

1. Try to find a story which tells how the compass helped Columbus to find his way across the ocean to America.

2. Try to find out how the compass is used by people today. Ask your father or your mother. Ask someone who has traveled on a long journey.

3. Try to think how a compass might be of use to you some day.



Index

HOW TO USE THE INDEX OF A BOOK

The Index will help you to find quickly what the book tells about something in which you are interested.

Suppose you want to find out about alligators. Look in the first part of the Index to find the word *Alligators*. After the word *Alligators* you will find the number 161. This means that page 161 in the book will tell you something about alligators. Look on page 161 to see what it says about alligators.

Suppose you want to find something about annuals. Here you see four page numbers—186, 187, 189, and 205. This means that you will find something about annuals on each of these four pages.

Words which begin with *A*, such as *Alligators* and *Annuals*, come in the first part of the Index. Then come words which begin with *B*, such as *Bears* and *Birds*. These are followed by words which begin with *C*, such as *Cactus* and *Coal*.

In which part of the Index should you look for words which begin with *M*? Find a page which tells about monkeys.

In what part of the Index should you look to find words which begin with *W*? Find a page which tells something about woodchucks.

You can use the Index to help find answers to questions, such as

1. What are magnets?
2. What is a magnetic compass?
3. What are magnetic poles?

Should you like to find answers to these questions?

Look for the words *Magnets*, *Magnetic compass*, *Magnetic poles*. Look at the page numbers after these words. On those pages you will find the answers to your questions.

Now see if you can use the Index by yourself.

What question do you want the book to answer?

Think of the most important word in the question.

Find this word in the Index. Look up the page numbers.

Read these pages to find the answer to your question.

Is this not a quick way to find what the book tells about something in which you are interested?

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VOCABULARY

The vocabulary of "Our Earth and Sky" has been carefully selected in order to hold reading difficulty to a minimum. A list of the assumed words is given in the teachers' manual which accompanies this book.

In addition to the assumed words, 350 new words have been gradually introduced. No more than five new words appear for the first time on any one page.

The following list includes the new words by pages:

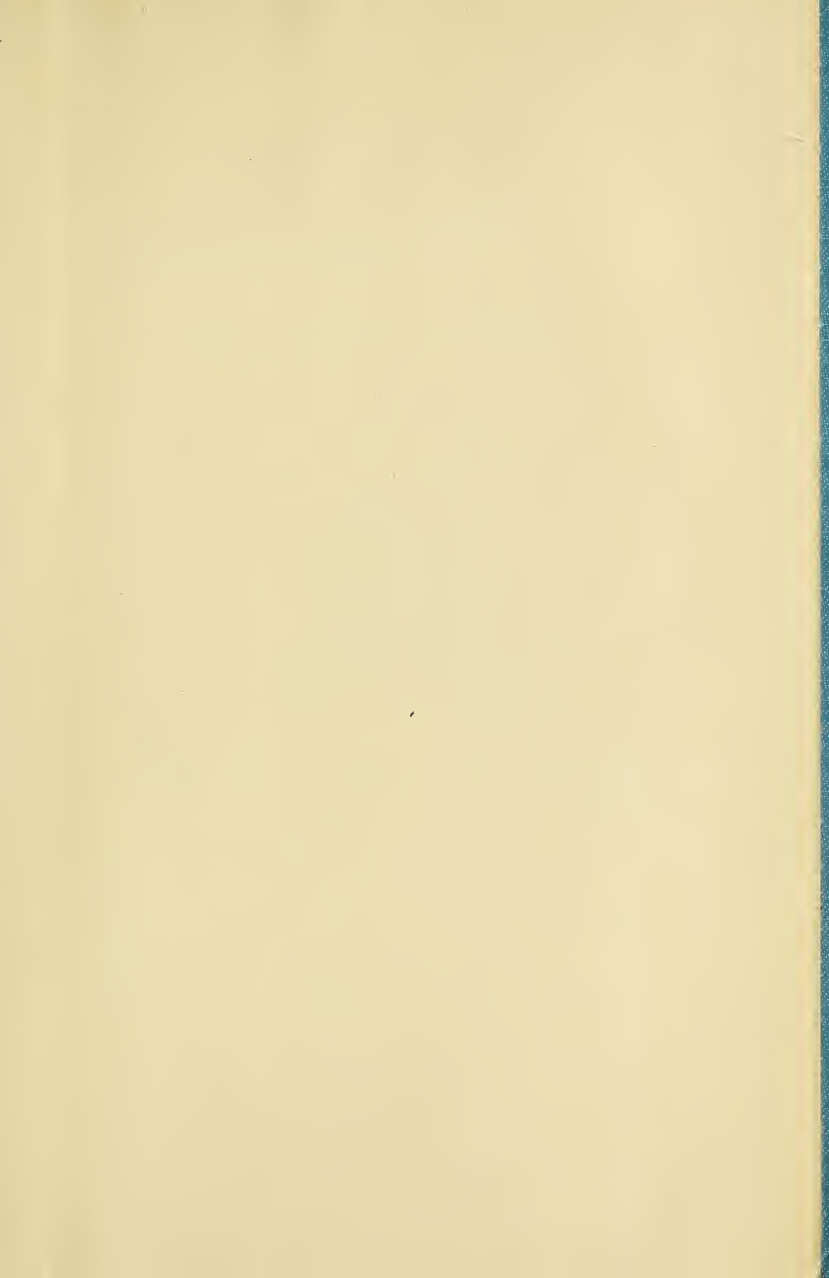
New Words by Pages

6. travels	19. whirling	41. dozen
science	20. shooting	needle
7. scientists	metal	hay
wrong	21. least	44. none
8. ninety-three	23. lamps	46. pours
pole	26. telescope	48. rays
trip	28. reflected	receives
journeys	mirror	51. taxis
probably	reflection	separated
9. several	although	violet
10. aviator	29. beyond	52. prism
gas	30. neighbor	balloons
eighty	31. sailor	whose
11. instead	32. magic	53. bluebell
born	pleasant	buttercup
fifty	desert	shirt
12. less	sharp	54. purple
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indeed	sentences	cereal
blackened	36. plainly	toast
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| 80. size | hibernate | cattle |
| crows | hibernation | 138. flows |
| pigeons | 108. spend | monarch butterfly |

- | | | |
|-----------------------|---------------------|-------------------|
| sight | 166. twins | 207. hidden |
| 140. sting | 167. weak | nutcracker |
| 141. oysters | colt | walnut |
| clams | herd | butternuts |
| crabs | whales | 208. rice |
| lobsters | 168. ruler | maples |
| 142. porcupines | 171. orioles | mountain ash |
| quills | 175. human | bittersweet |
| logs | 176. kangaroos | bunches |
| dangerous | 177. stickleback | 209. chance |
| 143. petrels | afterwards | scattered |
| 144. sidewinder snake | 178. sea horses | 212. burdocks |
| cockroaches | 180. goldfinch | sticktights |
| 145. creeping | grosbeaks | hooks |
| 147. fisheries | scarlet tanagers | knock |
| quail | 182. tumble | 213. tumbleweed |
| partridge | 186. autumn | Queen Anne's |
| pheasants | truly | lace |
| 148. starlings | annuals | 214. witch-hazel |
| 152. helpless | perennials | 215. jewelweed |
| opossums | 187. petunia | water ash |
| 153. puppy | 188. tomatoes | 217 a. dissolving |
| 155. codfish | 189. sweet peas | 217 b. chart |
| 156. salmon | 190. curly | written |
| salt | threads | spent |
| 157. cases | tendrils | 218. canary |
| mason wasps | 191. pods | 219. enjoy |
| 158. milkweed | 193. elm | puddle |
| fastens | replied | thirst |
| 159. cowbirds | 196. pots | windmills |
| chooses | 197. geraniums | pump |
| warblers | 198. begonias | 220. otters |
| 161. thirty | coleuses | 221. jellyfish |
| moist | 199. moisture | 223. tears |
| 163. jack rabbits | 202. specks | 224. muscles |
| 164. Mallard duck | oak | stomach |
| fifteen | teacups | 226. sirup |
| ducklings | 203. warmth | 228. broccoli |
| wide-awake | 206. forget-me-nots | lemons |

watermelon	245. blotting	sawdust
230. cactus	251. drill	ought
fig	signal	brass
232. donkey	252. third	267. magnetic pole
slipped	fourth	hung
sponges	fifth	268. rule
mixed	254. goldfish	269. magnetic field
233. lemonade	256. dew	filings
234. chewed	258. pressing	271. figure
238. neither	261. tire	272. scissors
239. cork	261 a. magnetic	274. lying
bobbing	compass	277. signboards
241. forth	261 b. interesting	278. hide-and-seek
243. chimney	263. steel	
roars	pen	



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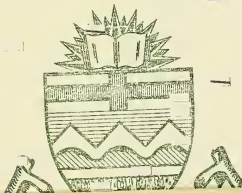
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